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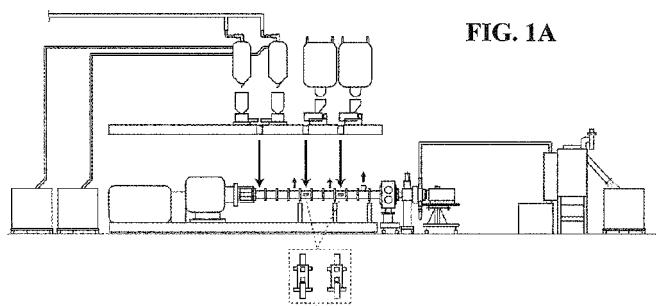


FIG. 1A

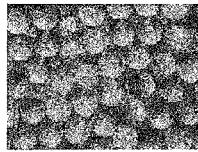


FIG. 1B

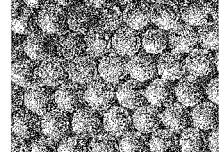


FIG. 1C

(57) **Abstract:** In various aspects, the present disclosure relates to fibers and fabric media comprising photoactivatable agents and to fibers and fabric media that are photoactivatable by photoactivation of the photoactivatable agents. In some instances, the fibers and the fabric media have photoactivatable agents present on their surface (e.g., the fiber/fabric is coated or sprayed with the photoactivatable agents or the fiber/fabric is dipped into a composition or a formulation comprising the photoactivatable agent). In other instances, the photoactivatable agents are incorporated into the materials making the fibers (e.g., the photoactivatable agents are mixed/compounded with the materials making the fibers). The photoactivatable fibers of the present disclosure comprise at least one thermoplastic polymer and at least photoactivatable agent that absorbs and emits light between about 400 nm and about 800 nm.

## PHOTOACTIVATABLE FIBERS AND FABRIC MEDIA

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of and priority to U.S. provisional patent application No. 62/073,795; filed October 31, 2014, the content of which is herein incorporated in its entirety by reference.

### FIELD OF TECHNOLOGY

The present disclosure generally relates to photoactivatable fibers and fabric media comprising photoactivatable agents, to methods of forming such photoactivatable fibers and fabric media, and to potential uses thereof.

### 10 BACKGROUND INFORMATION

Phototherapy has been recognized as having a wide range of applications in both the medical and cosmetic fields including use in surgery, therapy and diagnostics. For example, phototherapy has been used to treat cancers and tumors with lessened invasiveness, to disinfect target sites as an antimicrobial treatment, to treat skin conditions and to promote wound healing.

For these applications, phototherapy has typically been achieved using photoactivatable formulations and/or composition comprising photoactivatable agents capable of absorbing and/or emitting light. These photoactivatable formulations and/or compositions have typically been prepared and/or used as liquids or semi-liquids (e.g., gels, pastes, creams and the like). Due to their liquid and/or semi-liquid texture, some of these photoactivatable formulations and/or compositions exhibit leaching of the photoactivating agents out of the formulations and/or compositions. Also, these formulations and/or compositions require a support/surface onto which they can be applied. Because they tend to spread and/or dilute in contact with fluids, some liquid and semi-liquid photoactivatable formulations and/or compositions require multiple applications onto the surface to achieve the desired effect.

Therefore, the present disclosure relates to photoactivatable formulations having features that may present additional advantages over the photoactivatable formulations known to date. Such features may be useful in phototherapy and may contribute to a wider industrial applicability of the photoactivatable formulations.

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## OBJECT

It is an object of the present invention to provide one or more of a photoactivatable fiber, a photoactivatable fabric, an article of manufacture comprising a photoactivatable fabric, and a method for effecting phototherapy on a subject which overcome or ameliorate at least one of the problems of the prior art or provide an advantage as mentioned herein. Each object of the invention should be read disjunctively with the alternative object of to at least provide the public with a useful choice.

## SUMMARY OF DISCLOSURE

According to various aspects, the present disclosure relates to a photoactivatable fiber comprising: at least one thermoplastic polymer, and at least one photoactivatable agent; wherein the at least one photoactivatable agent absorbs and emits light between about 400 nm and about 800 nm.

In one aspect, the present disclosure relates to a photoactivatable fiber comprising: at least one thermoplastic polymer, and at least one xanthene dye; wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.

According to various aspects, the present disclosure relates to a photoactivatable fabric comprising a plurality of fibers composed of at least one thermoplastic polymer; and at least one photoactivatable agent, wherein the at least one photoactivatable agent absorbs and emits light between about 400 nm and about 800 nm.

In one aspect, the present disclosure relates to a photoactivatable fabric comprising a plurality of photoactivatable fibers wherein the photoactivatable fibers comprise: i) at least

one thermoplastic polymer, and ii) at least one xanthene dye; wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.

5 According to various aspects, the present disclosure relates to an article of manufacture comprising a photoactivatable fabric, wherein the photoactivatable fabric comprises: a) a plurality of fibers composed of at least one thermoplastic polymer; and b) at least one photoactivatable agent, wherein the at least one photoactivatable agent absorbs and emits light between about 400 nm and about 800 nm.

10 In one aspect, the present disclosure relates to an article of manufacture comprising a photoactivatable fabric, wherein the photoactivatable fabric comprises: a) a plurality of fibers composed of at least one thermoplastic polymer; and b) at least one xanthene dye; wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.

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According to various aspects, the present disclosure relates to a method for effecting phototherapy on a subject, the method comprising applying a photoactivatable fiber as defined herein onto the subject; and illuminating the photoactivatable fiber with light having a wavelength that overlaps with an absorption spectrum of the photoactivatable agent.

In one aspect, the present disclosure relates to a method for effecting phototherapy on a subject, the method comprising: applying a photoactivatable fiber as defined herein onto the subject; and illuminating the photoactivatable fiber with light having a wavelength that overlaps with an absorption spectrum of the at least one xanthene dye.

20

25 According to various aspects, the present disclosure relates to a method for effecting phototherapy on a subject, the method comprising applying a photoactivatable fabric as defined herein onto the subject; and illuminating the photoactivatable fabric with light having a wavelength that overlaps with an absorption spectrum of the photoactivatable agent.

According to various aspects, the present disclosure relates to a method for effecting phototherapy on a subject, the method comprising applying an article of manufacture as defined herein onto the subject; and illuminating the article of manufacture with light having a wavelength that overlaps with an absorption spectrum of the photoactivatable agent.

5 In one aspect, the present disclosure relates to a method for effecting phototherapy on a subject, the method comprising: applying an article of manufacture as defined herein onto the subject; and illuminating the article of manufacture with light having a wavelength that overlaps with an absorption spectrum of the at least one xanthene dye.

According to various aspects, the present disclosure relates to the use of a photoactivatable fiber as defined herein for effecting phototherapy to a subject.

10 According to various aspects, the present disclosure relates to the use of a photoactivatable fabric as defined herein for effecting phototherapy to a subject.

According to various aspects, the present disclosure relates to the use of an article of manufacture as defined herein for effecting phototherapy to a subject.

15 According to various aspects, the present disclosure relates to an article of manufacture comprising a first photoactivatable fabric; and a second photoactivatable fabric; wherein the first and second photoactivatable fabrics are associated with one another and comprise at least one photoactivatable agent that absorbs and emits light between about 400 nm and about 800 nm.

20 The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

25 Throughout this specification and the claims which follow, unless the context requires otherwise, the word “comprise”, and variations such as “comprises” and “comprising”, will

be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

### **BRIEF DESCRIPTION OF FIGURES**

**Figures 1A-1C.** Figure 1A illustrates a schematic representation of an extruder process used in the preparation of the photoactivatable fibers of the present disclosure. Figure 1B illustrates a picture of a cross-sectional view of fibers prepared by the extrusion process according to one embodiment of the present disclosure (Figure 1B showing the core of the fibers). Figure 1C illustrates a picture of a cross-sectional view of fibers prepared by extrusion process according to another embodiment of the present disclosure, wherein the fibers have a sheath and a core.

**Figures 2A-2D** illustrate graphs showing the fluorescence emission over time of a photoactivatable agent present in nylon fibers (Figure 2A), PBT fibers (Figure 2B), and PMMA fibers (Figure 2C). Figure 2D illustrates a graph comparing the effect of the polymers tested on fluorescence emission over time of the photoactivatable agents.

**Figure 3** illustrates a graph comparing the leaching of Eosin out of the indicated photoactivatable fibers according to one embodiment of the present disclosure.

**Figure 4** illustrates a graph showing the effect of addition of a lubricant to fluorescence emission by Eosin Y in solution.

5 **Figures 5A-5B.** Figure 5A illustrates a graph showing the effect of the presence of a lubricant on fluorescence emission of different concentrations of Eosin Y. Figure 5B illustrates a graph comparing the effect of the presence of a lubricant on fluorescence emission of Eosin Y and on fluorescence emission of fluorescein.

10 **Figures 6A-6B.** Figure 6A illustrates a graph comparing the fluorescence emission over time of a photoactivatable polypropylene fiber according to the present disclosure having 2, 4 or 6 layers of a EosinY:fluorescein composition on its surface. Figure 6B illustrates a graph comparing the fluorescence emission over time of a photoactivatable nylon fiber according to an embodiment of the present disclosure having 2, 4 or 6 layers of a fluorescein composition on its surface.

15 **Figure 7** illustrates a graph comparing the fluorescence emission of over time of photoactivatable nylon fibers according to one embodiment of the present disclosure having the photoactivatable agent present inside of the photoactivatable nylon fibers (inner) or on the surface (outer).

20 **Figures 8A-8F** illustrate pictures of the fluorescence emission of photoactivatable polypropylene fibers according to one embodiment of the present disclosure which were dipped in a solution of Eosin Y (0.1 g/L). Figures 8A and 8B show the fluorescence emission under blue lamp after one day wherein the fibers were not emerged in water. Figures 8C and 8D show the fluorescence emission under blue lamp after three days wherein the fibers were not emerged in water. Figures 8E and 8F show the fluorescence emission under blue lamp after three days emerged in water.

25 **Figures 9A-9P** illustrate pictures of the fluorescence emission under blue lamp of fibers dipped in a solution of photoactivatable agents, i.e., commercial dental fibers in Eosin Y

50g/L (Figures 9A-9B); commercial dental fibers in Eosin Y 0.1 g/L (Figures 9C-9D); commercial dental fibers in fluorescein 50g/L (Figures 9E-19F), commercial dental fibers in fluorescein 0.1g/L (Figures 9G-9H), commercial dental fibers in fluorescein:Eosin Y 50g/L (Figure 9I-9J), commercial dental fibers in fluorescein:Eosin Y 0.1g/L (Figures 9K-9L),  
5 polypropylene fibers in fluorescein 50g/L (Figures 9M-9N), polypropylene fibers in fluorescein 0.1g/L (Figures 9O-9P).

Figure 10 illustrates a schematic representation of a process for the preparation of photoactivatable fabrics according to one embodiment of the present disclosure.

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**Figures 11A-11B.** Figure 11A illustrates a schematic representation of an article of manufacture, in occurrence a suit-like garment, according to one embodiment of the present disclosure. Figure 11B illustrates a picture of a suit-like garment prepared with the photoactivatable fabrics according to one embodiment of the present disclosure.

15 **DETAILED DESCRIPTION**

In various aspects, the present disclosure relates to fibers and fabric media comprising photoactivatable agents and to fibers and fabric media that are photoactivatable by photoactivation of the photoactivatable agents. In some instances, the fibers and the fabric media have photoactivatable agents present on their surface (e.g., the fiber/fabric is coated or sprayed with the photoactivatable agents or the fiber/fabric is dipped into a composition or a formulation comprising the photoactivatable agent). In other instances, the photoactivatable agents are incorporated into the materials making the fibers (e.g., the photoactivatable agents are mixed/compounded with the materials making the fibers). In some other implementations, the photoactivatable agents are present both on the surface of 20 the fiber/fabric and incorporated/compounded into the materials making the fibers.  
25

In some instances, the fibers are, but not limited to, synthetic fibers, natural fibers, and textile fibers. For example, synthetic fibers may be made from a polymer or a combination of different polymers. In some instances, the polymer is a thermoplastic polymer.

As used herein, the term “fiber” relates to a string or a thread or a filament used as a component of composite materials. Fibers may be used in the manufacture of other materials such as for example, but not limited to, fabrics.

In some instances, the polymer is acrylic, acrylonitrile butadiene styrene (ABS), 5 polybenzimidazole (PBI), polycarbonate, polyether sulfone (PES), polyetherether ketone (PEEK), polyetherimide (PEI), polyethylene (PE), polyphenylene oxide (PPO), polyphenylene sulfide (PPS), polypropylene (PP), polystyrene, polyvinyl chloride (PVC), teflon, polybutylene, polyethylene terephthalate (PET), polybutylene terephthalate (PBT), nylon, polylactic acid (PLA), polymethyl methacrylate polyester, polyurethane, rayons, 10 poly(methyl methacrylate) (PMMA), or from any mixture thereof.

In some other instances, the fibers may be made from glycolic acid, copolymer lactide/glycolide, polyester polymer, copolymer polyglycolic acid/trimethylene carbonate, natural protein fiber, cellulose fiber, polyamide polymer, polymer of polypropylene, 15 polymer of polyethylene, nylon, polymer of polylactic acid, polymer of polybutylene terephthalate, polyester, copolymer polyglycol, polybutylene, polymer of poly methyl methacrylate, or from any mixture thereof.

In some implementations, the fibers of the present disclosure may be coextruded fibers that have two distinct polymers forming the fiber, usually as a core-sheath or side-by-side.

In some implementations, the fibers may be composed of a single strand (mono-filament) or 20 may be composed of a plurality of strands (multi-filaments). The photoactivatable fibers that are multifilament may also be intertwined or braided or twisted (i.e., the multifilaments are intertwined, braided or twisted to form the fibers).

In some implementations, the diameter of the photoactivatable fiber define herein (taken individually, monofilament) varies between about 15 microns and about 500 microns, 25 between about 25 microns and about 500 microns, between about 50 microns and 400 microns, between about 50 microns and about 300 microns, preferably between about 50 microns and about 250 microns, preferably between about 75 microns and about 300 microns, and most preferably between about 75 microns and about 250 microns. In some

specific implementations, the diameter of the photoactivatable fibers defined herein is about 15 microns, about 20 microns, about 25 microns, about 50 microns, about 75 microns, about 100 microns, about 125 microns, about 150 microns, about 175 microns, about 200 microns, about 225 microns, about 250 microns, about 250 microns, about 275 microns, about 300 microns, about 325 microns, about 350 microns, about 375 microns, about 400 microns, about 425 microns, about 450 microns, about 475 microns, about 500 microns. In some instances, the diameter of the photoactivatable fibers defined herein (taken individually) is about 31 microns.

In some implementations, the photoactivatable fibers defined herein show a medium to high resistance to mechanical pulling and stretching forces. In some implementations, the photoactivatable fibers defined here are resilient and have the ability to stretch and to reform to their original size and shape.

In some implementations, the photoactivatable fibers have a linear mass density of between about 400 and about 480 Deniers, between about 410 and about 470 Deniers, between about 420 and about 460 Deniers, between about 420 and about 450 Deniers, or about 428 Deniers. As used herein, the term “Denier” refers to a unit of measure for the linear mass density of fibers, is defined as the mass in grams per 9000 meters.

In some implementations, the fibers defined herein maintain their length and degree of flexibility and windability. In other implementation the stretch fibers may be lubricated to wind and unwind without damage being inflicted on the fibers due to the winding and the unwinding process. In some instance, the fibers have a tensile strength that allows the fibers to be stretched so as to reach a minimum diameter at least half, one third, one fourth, one fifth, one sixth, one seventh, one eighth, one ninth, or one tenth of the original diameter.

Figure 1A illustrates is a schematic representation of an example of a process for preparing photoactivatable fibers according to one embodiment of the present disclosure. In this example, an extrusion process is used wherein polymer pellets are melted and extruded and then pulled into a fiber while still hot. During this process a solution of photoactivatable agents in water and oil is sprayed onto the polymer while it is still hot. The fibers are then

spun onto a bobbin for storage and ease of use. In some instances, the photoactivatable fibers of the present disclosure are prepared using a TEM co-rotating twin screw extruder.

In some implementations, the photoactivatable agent is a chemical compound which, when exposed to the light is photoexcited and can then transfer its energy to other molecules or 5 emit it as light, such as for example fluorescence. For example, in some instances, the photoactivatable agent when photoexcited by the light may transfer its energy to enhance or accelerate light dispersion or to other molecules such as oxidants to release oxygen radicals. Examples of photoactivatable agents include, but are not limited to, fluorescent compounds (or stains) (also known as “fluorochromes” or “fluorophores” or “chromophores”). Other 10 dye groups or dyes (biological and histological dyes, food colorings, carotenoids, and other dyes) can also be used. Suitable photoactivatable agent can be those that are Generally Regarded As Safe (GRAS).

In certain implementations, the photoactivatable fibers of the present disclosure comprise a first photoactivatable agent. In some implementations, the first photoactivatable agent 15 absorbs at a wavelength in the range of the visible spectrum, such as at a wavelength of about 380 nm to about 800 nm, about 380 nm to about 700, about 400 nm to about 800, or about 380 nm to about 600 nm. In other embodiments, the first photoactivating agent absorbs at a wavelength of about 200 nm to about 800 nm, of about 200 nm to about 700 nm, of about 200 nm to about 600 nm or of about 200 nm to about 500 nm. In one 20 embodiment, the first photoactivatable agent absorbs at a wavelength of about 200 nm to about 600 nm. In some embodiments, the first photoactivatable agent absorbs light at a wavelength of about 200 nm to about 300 nm, of about 250 nm to about 350 nm, of about 300 nm to about 400 nm, of about 350 nm to about 450 nm, of about 400 nm to about 500 nm, of about 450 nm to about 650 nm, of about 600 nm to about 700 nm, of about 650 nm to 25 about 750 nm or of about 700 nm to about 800 nm.

In some implementations, the photoactivatable agents emit light within the range of about 400 nm and about 800 nm.

The photoactivatable fibers disclosed herein may include at least one additional photoactivatable agent. Combining photoactivatable agents may increase photo-absorption by the combined dye molecules and enhance absorption and photo-biomodulation selectivity. Thus, in certain embodiments, the photoactivatable fibers of the disclosure 5 include more than one photoactivatable agent.

In the implementations wherein the photoactivatable fibers have the photoactivatable agent on their surface (i.e., the surface of the fibers that is in contact with the surrounding environment of the fiber), such photoactivatable fibers may be prepared by being dipped 10 into a photoactivatable agent composition comprising one or more photoactivatable agents and a carrier material such as, but not limited to, water.

In other implementations wherein the photoactivatable fibers have the photoactivatable agent on their surface (i.e., the surface of the fibers that is in contact with the surrounding 15 environment of the fiber), such photoactivatable fibers may be prepared by being sprayed with a photoactivatable agent composition comprising one or more photoactivatable agents and a carrier material.

In some specific examples, the photoactivatable agent composition has a consistency that 20 allows the fibers to be dipped into the composition. In some specific examples, the photoactivatable agent composition is in a liquid or semi-liquid form.

The carrier material may be any liquid or semi liquid material that is compatible with the photoactivatable agent that is any material that does not affect the photoactive properties of 25 the photoactivatable agent, such as, for example, water. In some other specific examples, the photoactivatable agent composition has a consistency that allows the photoactivatable agent composition to be sprayed onto the fibers.

In the implementations wherein the photoactivatable fibers have the photoactivatable agent 30 incorporated into the fibers, the photoactivatable fibers are prepared by incorporating the photoactivatable agent into the fiber composition. In some examples, the photoactivatable

fibers are prepared by extrusion. In some specific implementations, the photoactivatable fibers are prepared by a process which uses spinning. The spinning may be wet, dry, dry jet-wet, melt, gel, or electrospinning. The polymer being spun may be converted into a fluid state. If the polymer is a thermoplastic then it may be melted, otherwise it may be dissolved in a solvent or may be chemically treated to form soluble or thermoplastic derivatives. The molten polymer is then forced through the spinneret, and then it cools to a rubbery state, and then a solidified state. If a polymer solution is used, then the solvent is removed after being forced through the spinneret. A composition of the photoactivatable agent may be added to the polymer in the fluid state or to the melted polymer or to the polymer dissolved into a solvent. Melt spinning may be used for polymers that can be melted. The polymer having the photoactivatable agents dispersed therein solidifies by cooling after being extruded from the spinneret.

The photoactivatable agent may be uniformly or a non-uniformly distributed within the photoactivatable fibers. When the photoactivatable ingredient is uniformly distributed in the photoactivatable fibers, the concentration of photoactivatable agent in the photoactivatable fibers is steady as the photoactivatable fibers disintegrate, whereas when the photoactivatable agent is not uniformly distributed within the photoactivatable fibers, the concentration of the photoactivatable agent in the photoactivatable fibers varies as the photoactivatable fibers disintegrate.

The concentration of the photoactivatable agent to be used may be selected based on the desired intensity and duration of the photoactivity to be emitted from the photoactivatable fibers, and on the desired phototherapeutic, medical or cosmetic effect. For example, some dyes such as xanthene dyes reach a ‘saturation concentration’ after which further increases in concentration do not provide substantially higher emitted fluorescence. Further increasing the photoactivatable agent concentration above the saturation concentration can reduce the amount of activating light passing through the photoactivatable fibers. Therefore, if more fluorescence is required for a certain application than activating light, a high concentration of photoactivatable agent can be used. However, if a balance is required between the emitted

fluorescence and the activating light, a concentration close to or lower than the saturation concentration can be chosen.

Suitable photoactivatable agent that may be used in the photoactivatable fibers of the

5 present disclosure include, but are not limited to the following:

*Chlorophyll dyes* - chlorophyll dyes include but are not limited to chlorophyll a; chlorophyll b; chlorophyllin; bacteriochlorophyll a; bacteriochlorophyll b; bacteriochlorophyll c; bacteriochlorophyll d; protochlorophyll; protochlorophyll a; amphiphilic chlorophyll derivative 1; and amphiphilic chlorophyll derivative 2.

*Xanthene derivatives* - xanthene dyes include but are not limited to eosin, eosin B (4',5'-dibromo,2',7'-dinitro- o-fluorescein, dianion); eosin Y; eosin Y (2',4',5',7'-tetrabromo-fluorescein, dianion); eosin (2',4',5',7'-tetrabromo-fluorescein, dianion); eosin (2',4',5',7'-tetrabromo-fluorescein, dianion) methyl ester; eosin (2',4',5',7'-tetrabromo-fluorescein, monoanion) p-isopropylbenzyl ester; eosin derivative (2',7'-dibromo-fluorescein, dianion);

15 eosin derivative (4',5'-dibromo-fluorescein, dianion); eosin derivative (2',7'-dichloro-fluorescein, dianion); eosin derivative (4',5'-dichloro-fluorescein, dianion); eosin derivative (2',7'-diiodo-fluorescein, dianion); eosin derivative (4',5'-diiodo-fluorescein, dianion); eosin

20 derivative (tribromo-fluorescein, dianion); eosin derivative (2',4',5',7'-tetrachloro-fluorescein, dianion); eosin dicetylpyridinium chloride ion pair; erythrosin B (2',4',5',7'-tetraiodo-fluorescein, dianion); erythrosin; erythrosin dianion; erythrosin B; fluorescein; fluorescein dianion; phloxin B (2',4',5',7'-tetrabromo-3,4,5,6-tetrachloro-fluorescein, dianion); phloxin B (tetrachloro-tetrabromo-fluorescein); phloxine B; rose bengal (3,4,5,6-

25 tetrachloro-2',4',5',7'-tetraiodofluorescein, dianion); pyronin G, pyronin J, pyronin Y; Rhodamine dyes such as rhodamines that include, but are not limited to, 4,5-dibromo-rhodamine methyl ester; 4,5-dibromo-rhodamine n-butyl ester; rhodamine 101 methyl ester; rhodamine 123; rhodamine 6G; rhodamine 6G hexyl ester; tetrabromo-rhodamine 123; and tetramethyl-rhodamine ethyl ester.

*Methylene blue dyes* - methylene blue derivatives include, but are not limited to, 1-methyl methylene blue; 1,9-dimethyl methylene blue; methylene blue; methylene blue (16  $\mu$ M); methylene blue (14  $\mu$ M); methylene violet; bromomethylene violet; 4-iodomethylene violet; 1,9-dimethyl-3-dimethyl-amino-7-diethyl-a-mino-phenothiazine; and 1,9-dimethyl-3-diethylamino-7-dibutyl-amino-phenothiazine.

*Azo dyes* - azo (or diazo-) dyes include but are not limited to methyl violet, neutral red, para red (pigment red 1), amaranth (Azorubine S), Carmoisine (azorubine, food red 3, acid red 14), allura red AC (FD&C 40), tartrazine (FD&C Yellow 5), orange G (acid orange 10), Ponceau 4R (food red 7), methyl red (acid red 2), and murexide-ammonium purpurate.

In some aspects of the disclosure, the one or more photoactivatable agents of the photoactivatable fibers disclosed herein can be independently selected from any of Acid black 1, Acid blue 22, Acid blue 93, Acid fuchsin, Acid green, Acid green 1, Acid green 5, Acid magenta, Acid orange 10, Acid red 26, Acid red 29, Acid red 44, Acid red 51, Acid red 66, Acid red 87, Acid red 91, Acid red 92, Acid red 94, Acid red 101, Acid red 103, Acid roseine, Acid rubin, Acid violet 19, Acid yellow 1, Acid yellow 9, Acid yellow 23, Acid yellow 24, Acid yellow 36, Acid yellow 73, Acid yellow S, Acridine orange, Acriflavine, Alcian blue, Alcian yellow, Alcohol soluble eosin, Alizarin, Alizarin blue 2RC, Alizarin carmine, Alizarin cyanin BBS, Alizarol cyanin R, Alizarin red S, Alizarin purpurin, Aluminon, Amido black 10B, Amidoschwarz, Aniline blue WS, Anthracene blue SWR, Auramine O, Azocannine B, Azocarmine G, Azoic diazo 5, Azoic diazo 48, Azure A, Azure B, Azure C, Basic blue 8, Basic blue 9, Basic blue 12, Basic blue 15, Basic blue 17, Basic blue 20, Basic blue 26, Basic brown 1, Basic fuchsin, Basic green 4, Basic orange 14, Basic red 2, Basic red 5, Basic red 9, Basic violet 2, Basic violet 3, Basic violet 4, Basic violet 10, Basic violet 14, Basic yellow 1, Basic yellow 2, Biebrich scarlet, Bismarck brown Y, Brilliant crystal scarlet 6R, Calcium red, Carmine, Carminic acid, Celestine blue B, China blue, Cochineal, Coelstine blue, Chrome violet CG, Chromotrope 2R, Chromoxane cyanin R, Congo corinth, Congo red, Cotton blue, Cotton red, Croceine scarlet, Crocin, Crystal ponceau 6R, Crystal violet, Dahlia, Diamond green B, Direct blue 14, Direct blue 58, Direct red, Direct red 10, Direct red 28, Direct red 80, Direct yellow 7, Eosin B, Eosin Bluish,

Eosin, Eosin Y, Eosin yellowish, Eosinol, Erie garnet B, Eriochrome cyanin R, Erythrosin B, Ethyl eosin, Ethyl green, Ethyl violet, Evans blue, Fast blue B, Fast green FCF, Fast red B, Fast yellow, Fluorescein, Food green 3, Gallein, Gallamine blue, Gallocyanin, Gentian violet, Haematein, Haematine, Haematoxylin, Helio fast rubin BBL, Helvetia blue, 5 Hematein, Hematine, Hematoxylin, Hoffman's violet, Imperial red, Indocyanin Green, Ingrain blue, Ingrain blue 1, Ingrain yellow 1, INT, Kermes, Kermesic acid, Kernechtrot, Lac, Laccaic acid, Lauth's violet, Light green, Lissamine green SF, Luxol fast blue, Magenta 0, Magenta I, Magenta II, Magenta III, Malachite green, Manchester brown, Martius yellow, 10 Merbromin, Mercurochrome, Metanil yellow, Methylene azure A, Methylene azure B, Methylene azure C, Methylene blue, Methyl blue, Methyl green, Methyl violet, Methyl violet 2B, Methyl violet 10B, Mordant blue 3, Mordant blue 10, Mordant blue 14, Mordant blue 23, Mordant blue 32, Mordant blue 45, Mordant red 3, Mordant red 11, Mordant violet 25, Mordant violet 39 Naphthol blue black, Naphthol green B, Naphthol yellow S, Natural black 1, Natural green 3(chlorophyllin), Natural red, Natural red 3, Natural red 4, Natural 15 red 8, Natural red 16, Natural red 25, Natural red 28, Natural yellow 6, NBT, Neutral red, New fuchsin, Niagara blue 3B, Night blue, Nile blue, Nile blue A, Nile blue oxazone, Nile blue sulphate, Nile red, Nitro BT, Nitro blue tetrazolium, Nuclear fast red, Oil red O, Orange G, Orcein, Pararosanilin, Phloxine B, Picric acid, Ponceau 2R, Ponceau 6R, Ponceau B, Ponceau de Xylidine, Ponceau S, Primula, Purpurin, Pyronin B, phycobilins, 20 Phycocyanins, Phycoerythrins. Phycoerythrincyanin (PEC), Phthalocyanines, Pyronin G, Pyronin Y, Quinine, Rhodamine B, Rosanilin, Rose bengal, Saffron, Safranin O, Scarlet R, Scarlet red, Scharlach R, Shellac, Sirius red F3B, Solochrome cyanin R, Soluble blue, Solvent black 3, Solvent blue 38, Solvent red 23, Solvent red 24, Solvent red 27, Solvent red 45, Solvent yellow 94, Spirit soluble eosin, Sudan III, Sudan IV, Sudan black B, Sulfur 25 yellow S, Swiss blue, Tartrazine, Thioflavine S, Thioflavine T, Thionin, Toluidine blue, Toluylene red, Tropaeolin G, Trypaflavine, Trypan blue, Uranin, Victoria blue 4R, Victoria blue B, Victoria green B, Vitamin B, Water blue I, Water soluble eosin, Xylidine ponceau, or Yellowish eosin.

30 In certain embodiments, the photoactivatable fibers of the present disclosure may include any of the photoactivatable agents listed above, or a combination thereof, so as to provide a

synergistic biophotonic effect. For example, the following synergistic combinations of photoactivatable agents may be used: Eosin Y and Fluorescein; Fluorescein and Rose Bengal; Erythrosine in combination with Eosin Y, Rose Bengal or Fluorescein; Phloxine B in combination with one or more of Eosin Y, Rose Bengal, Fluorescein and Erythrosine; 5 Eosin Y, Fluorescein and Rose Bengal.

In some examples, the photoactivatable agent is present in the photoactivatable agent composition at a concentration of about 100 g/L, about 50 g/L, about 10 g/L, about 5 g/L, about 1 g/L or about 0.1 g/L of the total volume. Preferably, the photoactivatable agent is 10 present in the photoactivatable agent composition at a concentration of between about 10 g/L and about 100 g/L. In some instances, the photoactivatable agent is present in the photoactivatable agent composition at a concentration that is lower than 0.1 g/L, for example, the photoactivatable agent is present in the photoactivatable agent composition at a concentration in the milligram/L or in the microgram/L range.

15

In some embodiments, the photoactivatable fibers of the present disclosure comprise a lubricant. In some instances, the lubricant is coated onto the photoactivatable fibers of the present disclosure. In some instances, the lubricant is treatment oil, such as but not limited to Lurol Oil<sup>TM</sup>. Without wishing to be bound by theory, the addition of a lubricant to the 20 surface of the fibers improves the retention of the composition of photoactivatable agents onto the fibers. For example, the lubricant improves the hydrophilicity of the polymer so that it increases the absorption of the solution of photoactivatable agent.

25

In some implementations, there is less than about 15% leaching of the photoactivatable agent out of the photoactivatable fibers of the present disclosure, more preferably less than 10%, more preferably less than 5%, more preferably less than 4%, more preferably less than 3%, more preferably less than 2%, more preferably less than 1%, or even more preferably substantially no leaching of the photoactivatable agent out of the photoactivatable fibers. Leaching of the photoactivatable agent out of the photoactivatable fibers of the present 30 disclosure may be assessed by placing 0.1g of the photoactivatable fibers in 10 ml of water for 1 day and by then measuring the amount of photoactivatable agent in the water.

In some implementations, the photoactivatable fibers as defined herein may be woven into a fabric material resulting in a photoactivatable fabric comprising a plurality of photoactivatable fibers. In some implementations, the photoactivatable fabric comprising the photoactivatable fibers exhibits substantially no leaching of the photoactivatable agent.

As used herein, the term “fabric” relates to a woven material composed of a network of fibers or to a non-woven (e.g., spunbound) material composed of fibers. Weaving is a method of textile production in which two distinct sets of yarns or threads are interlaced at right angles to form a fabric or cloth. Similar methods are knitting, felting, and braiding or plaiting. Non-woven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments mechanically, thermally or chemically. They are flat or tufted porous sheets that are made directly from separate fibers, molten plastic or plastic film. They are not made by weaving or knitting and do not require converting the fibers to yarn.

In some examples, the fabric material may be used in the fabrication of an article of manufacture such as, but not limited to, a garment, an article of clothing, a wound dressing, a towel, bedding, and the like. In some implementation the garment may be a shirt, pants, glove, mask, socks, or the like. In some instances, the photoactivatable fibers of the present disclosure are woven into a fabric material is a suit or a suit-like garment.

In the implementations wherein the photoactivatable agents are compounded with the polymer of the fibers, the fabric made from such fibers is also photoactivatable. Whereas in the implementations wherein the photoactivatable agents are not compounded with the polymer of the fibers, the fabric made from such fibers may be coated or dipped or sprayed with a photoactivatable agent composition to render the fabric photoactivatable.

In some other examples, the photoactivatable fabric may be a nonwoven photoactivatable fabric such as but not limited to a spunbound fabric. Spunbond fabrics may be produced by depositing extruded, spun filaments onto a collecting belt in a uniform random manner followed by bonding the fibers. The fibers may be separated during the web laying process

by air jets or electrostatic charges. The collecting surface is usually perforated to prevent the air stream from deflecting and carrying the fibers in an uncontrolled manner. Bonding imparts strength and integrity to the web by applying heated rolls or hot needles to partially melt the polymer and fuse the fibers together. In general, high molecular weight and broad 5 molecular weight distribution polymers such as, but not limited to, polypropylene, polyester, polyethylene, polyethylene terephthalate, nylon, polyurethane, and rayons may be used in the manufacture of spunbound fabrics. In some instances, spunbound fabrics may be composed of a mixture of polymers. A lower melting polymer can function as the binder which may be a separate fiber interspersed with higher melting fibers, or two polymers may 10 be combined into a single fiber type. In the latter case the so-called bi-component fibers possess a lower melting component, which acts as a sheath covering over a higher melting core. Bicomponent fibers may also spun by extrusion of two adjacent polymers.

In some instances, sp unbonding may combine fiber spinning with web formation by placing the bonding device in line with spinning. In some arrangements the web may be bonded in a 15 separate step. The spinning process may be similar to the production of continuous filament yarns and may utilize similar extruder conditions for a given polymer. Fibers are formed as the molten polymer exits the spinnerets and is quenched by cool air. The objective of the process is to produce a wide web and, therefore, many spinnerets are placed side by side to generate sufficient fibers across the total width.

20 Before deposition on a moving belt or screen, the output of a spinneret usually includes a plurality of individual filaments which must be attenuated to orient molecular chains within the fibers to increase fiber strength and decrease extensibility. This is accomplished by rapidly stretching the plastic fibers immediately after exiting the spinneret. In practice the fibers are accelerated either mechanically or pneumatically. The web is formed by the 25 pneumatic deposition of the filament bundles onto the moving belt. A pneumatic gun uses high-pressure air to move the filaments through a constricted area of lower pressure, but higher velocity as in a venturi tube. In order for the web to achieve maximum uniformity and cover, individual filaments are separated before reaching the belt. This is accomplished by inducing an electrostatic charge onto the bundle while under tension and before 30 deposition. The charge may be induced triboelectrically or by applying a high voltage

charge. The belt is usually made of an electrically grounded conductive wire. Upon deposition, the belt discharges the filaments. Webs produced by spinning linearly arranged filaments through a so-called slot die eliminating the need for such bundle separating devices.

5 Many methods can be used to bond the fibers in the spun web. These include mechanical needling, thermal bonding, and chemical bonding. The last two may bond large regions (area bonding) or small regions (point bonding) of the web by fusion or adhesion of fibers. Point bonding results in the fusion of fibers at points, with fibers between the point bonds remaining relatively free. Other methods used with staple fiber webs, but not routinely with

10 continuous filament webs include stitch bonding, ultrasonic fusing, and hydraulic entanglement.

The photoactivatable fabrics of the present disclosure preferably have a thickness that allows light to reach the photoactivatable agents embedded in the fibers of the fabric and for the light emitted by the photoactivatable agents to exit the fabric.

15 In some embodiments, the photoactivatable fibers and the photoactivatable fabrics of the present disclosure may have cosmetic and/or medical benefits.

In some implementations of these embodiments, the photoactivatable fibers and the photoactivatable fabrics may be used to promote prevention and/or treatment of a tissue or an organ and/or to treat a tissue or an organ of a subject in need of phototherapy.

20 In some instances, the photoactivatable fibers and/fabrics of the present disclosure may be used to promote treatment of a skin disorder such as acne, eczema, dermatitis or psoriasis, promote tissue repair, and modulate inflammation, modulate collagen synthesis, reduce or avoid scarring, for cosmesis, or promote wound healing. They can be used to treat acute inflammation. Acute inflammation can present itself as pain, heat, redness, swelling and loss of function, and includes inflammatory responses such as those seen in allergic reactions such as those to insect bites e.g.; mosquito, bees, wasps, poison ivy, or post-ablative treatment.

In certain instance, the photoactivatable fibers and/fabrics of the present disclosure may provide treatment of a skin disorder, preventing or treating scarring, and/or accelerating wound healing and/or tissue repair.

5 In certain embodiments, the photoactivatable fibers or fabrics may be used to promote wound healing. In this case, the photoactivatable fibers or fabrics may be applied at wound site as deemed appropriate by the physician or other health care providers. In certain embodiments, the photoactivatable fibers or fabrics may be used following wound closure to optimize scar revision. In this case, the photoactivatable fibers or fabrics may be applied at  
10 regular intervals such as once a week, or at an interval deemed appropriate by the physician or other health care providers.

In certain embodiments, the photoactivatable fibers or fabrics may be used following acne treatment to maintain the condition of the treated skin. In this case, the photoactivatable  
15 fibers or fabrics may be applied at regular intervals such as once a week, or at an interval deemed appropriate by the physician or other health care providers.

In certain embodiments, the photoactivatable fibers or fabrics may be used following ablative skin treatment to maintain the condition of the treated skin.

20 The photoactivatable fibers or fabrics of the present disclosure may be used to treat skin disorders that include, but are not limited to, erythema, telangiectasia, actinic telangiectasia, basal cell carcinoma, contact dermatitis, dermatofibrosarcoma protuberans, genital warts, hidradenitis suppurativa, melanoma, merkel cell carcinoma, nummular dermatitis, molloscum contagiosum, psoriasis, psoriatic arthritis, rosacea, scabies, scalp psoriasis, sebaceous carcinoma, squamous cell carcinoma, seborrheic dermatitis, seborrheic keratosis, shingles, tinea versicolor, warts, skin cancer, pemphigus, sunburn, dermatitis, eczema, rashes, impetigo, lichen simplex chronicus, rhinophyma, perioral dermatitis, pseudofolliculitis barbae, drug eruptions, erythema multiforme, erythema nodosum, granuloma annulare, actinic keratosis, purpura, alopecia areata, aphthous stomatitis, dry skin, chapping, xerosis, fungal infections, herpes simplex, intertrigo, keloids, keratoses,

milia, molluscum contagiosum, pityriasis rosea, pruritus, urticaria, and vascular tumors and malformations. Dermatitis includes contact dermatitis, atopic dermatitis, seborrheic dermatitis, nummular dermatitis, generalized exfoliative dermatitis, and stasis dermatitis. Skin cancers include melanoma, basal cell carcinoma, and squamous cell carcinoma.

5

The photoactivatable fibers or fabrics of the present disclosure may be used to treat acne. As used herein, "acne" means a disorder of the skin caused by inflammation of skin glands or hair follicles. The photoactivatable fibers or fabrics of the disclosure can be used to treat acne at early pre-emergent stages or later stages where lesions from acne are visible. Mild, 10 moderate and severe acne can be treated with embodiments of photoactivatable fibers or fabrics. Early pre-emergent stages of acne usually begin with an excessive secretion of sebum or dermal oil from the sebaceous glands located in the pilosebaceous apparatus. Sebum reaches the skin surface through the duct of the hair follicle. The presence of excessive amounts of sebum in the duct and on the skin tends to obstruct or stagnate the 15 normal flow of sebum from the follicular duct, thus producing a thickening and solidification of the sebum to create a solid plug known as a comedone. In the normal sequence of developing acne, hyperkeratinization of the follicular opening is stimulated, thus completing blocking of the duct. The usual results are papules, pustules, or cysts, often contaminated with bacteria, which cause secondary infections. Acne is characterized 20 particularly by the presence of comedones, inflammatory papules, or cysts. The appearance of acne may range from slight skin irritation to pitting and even the development of disfiguring scars. Accordingly, the photoactivatable fibers or fabrics of the present disclosure can be used to treat one or more of skin irritation, pitting, development of scars, comedones, inflammatory papules, cysts, hyperkeratinization, and thickening and hardening 25 of sebum associated with acne.

Some skin disorders present various symptoms including redness, flushing, burning, scaling, pimples, papules, pustules, comedones, macules, nodules, vesicles, blisters, telangiectasia, spider veins, sores, surface irritations or pain, itching, inflammation, red, purple, or blue 30 patches or discolorations, moles, and/or tumors.

The photoactivatable fibers or fabrics of the present disclosure may be used to treat various types of acne. Some types of acne include, for example, acne vulgaris, cystic acne, acne atrophica, bromide acne, chlorine acne, acne conglobata, acne cosmetica, acne detergicans, epidemic acne, acne estivalis, acne fulminans, halogen acne, acne indurata, iodide acne, 5 acne keloid, acne mechanica, acne papulosa, pomade acne, premenstral acne, acne pustulosa, acne scorbutica, acne scrofulosorum, acne urticata, acne varioliformis, acne venenata, propionic acne, acne excoriée, gram negative acne, steroid acne, and nodulocystic acne.

10 In certain embodiments, the photoactivatable fibers or fabrics of the present disclosure are used in conjunction with systemic or topical antibiotic treatment. For example, antibiotics used to treat acne include tetracycline, erythromycin, minocycline, doxycycline. In some implementations, the article of manufacture being composed of the photoactivatable fabric of the present disclosure may have an anti-infective effect, for example when used in the 15 treatment of a wound to prevent infection and/or re-infection of the wound by bacteria or by other infective agents.

20 The photoactivatable fibers or fabrics of the present disclosure may be used to treat wounds, promote wound healing, promote tissue repair and/or prevent or reduce cosmesis including improvement of motor function (e.g. movement of joints). Wounds that may be treated by the photoactivatable fibers and fabrics of the present disclosure include, for example, 25 injuries to the skin and subcutaneous tissue initiated in different ways (e.g., pressure ulcers from extended bed rest, wounds induced by trauma or surgery, burns, ulcers linked to diabetes or venous insufficiency) and with varying characteristics. In certain embodiments, the present disclosure provides photoactivatable fibers or fabrics for treating and/or promoting the healing of, for example, burns, incisions, excisions, lesions, lacerations, abrasions, puncture or penetrating wounds, surgical wounds, contusions, hematomas, crushing injuries, amputations, sores and ulcers.

30 In some embodiments, the photoactivatable fibers and fabrics of the present disclosure may be used in a method for effecting phototherapy on a subject, such as on a tissue and/or an

organ of the subject. Such method comprises the step of applying a photoactivatable fibers and fabric as defined herein onto the subject or onto the tissue or the organ in need of phototherapy and the step of illuminating the photoactivatable fiber and fabric with light having a wavelength that overlaps with that overlaps with an absorption spectrum of the  
5 photoactivatable agent.

In certain instances, the photoactivatable fibers and fabrics of the present disclosure may be used in phototherapy and/or in biophotonic therapy. In certain instances, the photoactivatable fibers and fabrics of the present disclosure may be used as biophotonic medical devices.

10 In certain instances, the photoactivatable fibers and fabrics of the present disclosure may be used in the manufacture of medical devices such as suture materials, stents, catheter, balloons, wound dressing or the like. In some other embodiments, the photoactivatable fibers may be used in the fabrication of dental care devices such as in the fabrication of toothbrush, dental floss, braces and the like.

15 The methods of the present disclosure comprise applying a photoactivatable fiber or photoactivatale fabric of the present disclosure to a tissue or organ in need of phototherapy and illuminating the photoactivatable fiber or photoactivatale fabric with light having a wavelength that overlaps with an absorption spectrum of the photoactivatable agent(s) present in the photoactivatable fiber or photoactivatable fabric to induce emission of the  
20 photoactivatable agent(s).

In the methods of the present disclosure, any source of actinic light can be used. Any type of halogen, LED or plasma arc lamp, or laser may be suitable. The primary characteristic of suitable sources of actinic light will be that they emit light in a wavelength (or wavelengths) appropriate for activating the one or more photoactivatable agent present in the composition.  
25 In one embodiment, an argon laser is used. In another embodiment, a potassium-titanyl phosphate (KTP) laser (e.g. a GreenLight™ laser) is used. In yet another embodiment, a LED lamp such as a photocuring device is the source of the actinic light. In yet another embodiment, the source of the actinic light is a source of light having a wavelength between

about 200 to 800 nm. In another embodiment, the source of the actinic light is a source of visible light having a wavelength between about 400 and 600 nm. In another embodiment, the source of the actinic light is a source of visible light having a wavelength between about 400 and 700 nm. In yet another embodiment, the source of the actinic light is blue light. In 5 yet another embodiment, the source of the actinic light is red light. In yet another embodiment, the source of the actinic light is green light. Furthermore, the source of actinic light should have a suitable power density. Suitable power density for non-collimated light sources (LED, halogen or plasma lamps) are in the range from about 0.1 mW/cm<sup>2</sup> to about 200 mW/cm<sup>2</sup>. Suitable power density for laser light sources are in the range from about 0.5 10 mW/cm<sup>2</sup> to about 0.8 mW/cm<sup>2</sup>.

In some implementations, the light has an energy at the subject's skin surface of between about 0.1 mW/cm<sup>2</sup> and about 500 mW/cm<sup>2</sup>, or 0.1-300 mW/cm<sup>2</sup>, or 0.1-200 mW/cm<sup>2</sup>, wherein the energy applied depends at least on the condition being treated, the wavelength 15 of the light, the distance of the skin from the light source and the thickness of the photoactivatable fibers or fabrics. In certain embodiments, the light at the subject's skin is between about 1-40 mW/cm<sup>2</sup>, or between about 20-60 mW/cm<sup>2</sup>, or between about 40-80 mW/cm<sup>2</sup>, or between about 60-100 mW/cm<sup>2</sup>, or between about 80-120 mW/cm<sup>2</sup>, or between 20 about 100-140 mW/cm<sup>2</sup>, or between about 30-180 mW/cm<sup>2</sup>, or between about 120-160 mW/cm<sup>2</sup>, or between about 140-180 mW/cm<sup>2</sup>, or between about 160-200 mW/cm<sup>2</sup>, or between about 110-240 mW/cm<sup>2</sup>, or between about 110-150 mW/cm<sup>2</sup>, or between about 20 190-240 mW/cm<sup>2</sup>.

The activation of the photoactivatable agents may take place almost immediately on 25 illumination (femto- or pico seconds). A prolonged exposure period may be beneficial to exploit the synergistic effects of the absorbed, reflected and reemitted light of the photoactivatable fibers and fabrics of the present disclosure and its interaction with the tissue being treated. In one embodiment, the time of exposure of photoactivatable fibers or fabrics to actinic light is a period between 0.01 minutes and 90 minutes. In another embodiment, the time of exposure of the photoactivatable fibers or fabrics to actinic light is 30 a period between 1 minute and 5 minutes. In some other embodiments, the photoactivatable

fibers or fabrics are illuminated for a period between 1 minute and 3 minutes. In certain embodiments, light is applied for a period of about 1-30 seconds, about 15-45 seconds, about 30-60 seconds, about 0.75-1.5 minutes, about 1-2 minutes, about 1.5-2.5 minutes, about 2-3 minutes, about 2.5-3.5 minutes, about 3-4 minutes, about 3.5-4.5 minutes, about 5 4-5 minutes, about 5-10 minutes, about 10-15 minutes, about 15-20 minutes, or about 20-30 minutes. The treatment time may range up to about 90 minutes, about 80 minutes, about 70 minutes, about 60 minutes, about 50 minutes, about 40 minutes or about 30 minutes. It will be appreciated that the treatment time can be adjusted in order to maintain a dosage by adjusting the rate of fluence delivered to a treatment area. For example, the delivered 10 fluence may be about 4 to about 60 J/cm<sup>2</sup>, 4 to about 90 J/cm<sup>2</sup>, 10 to about 90 J/cm<sup>2</sup>, about 10 to about 60 J/cm<sup>2</sup>, about 10 to about 50 J/cm<sup>2</sup>, about 10 to about 40 J/cm<sup>2</sup>, about 10 to about 30 J/cm<sup>2</sup>, about 20 to about 40 J/cm<sup>2</sup>, about 15 J/cm<sup>2</sup> to 25 J/cm<sup>2</sup>, or about 10 to about 20 J/cm<sup>2</sup>.

15 In certain embodiments, the photoactivatable fibers and photoactivatable fabric may be re-illuminated at certain intervals. In yet another embodiment, the source of actinic light is in continuous motion over the treated area for the appropriate time of exposure. In yet another embodiment, the photoactivatable fibers or photoactivatable fabric may be illuminated until the photoactivatable fibers or photoactivatable fabric is at least partially photobleached or 20 fully photobleached.

In certain embodiments, the photoactivatable agents in the photoactivatable fibers or fabrics can be photoexcited by ambient light including from the sun and overhead lighting. In certain embodiments, the photoactivatable agents can be photoactivated by light in the 25 visible range of the electromagnetic spectrum. The light can be emitted by any light source such as sunlight, light bulb, an LED device, electronic display screens such as on a television, computer, telephone, mobile device, flashlights on mobile devices. In the methods of the present disclosure, any source of light can be used. For example, a combination of ambient light and direct sunlight or direct artificial light may be used. 30 Ambient light can include overhead lighting such as LED bulbs, fluorescent bulbs, and indirect sunlight.

In the methods of the present disclosure, the photoactivatable fibers or fabric may be removed from the tissue or organ following application of light. In other embodiments, the photoactivatable fibers or fabric may be left on the tissue or organ for an extended period of 5 time and re-activated with direct or ambient light at appropriate times to treat the condition.

## EXAMPLES

### *EXAMPLE 1*

#### *Preparation of photoactivatable fibers and photoactivatable fabrics*

Chromophores were incorporated into fibers made of polymer materials (polymer materials compounded with chromophores). The compounding involved taking a polymer melt and adding the chromophores in their solid form directly to the polymer, and then allowing the 15 melt to cool. This process allowed chromophores to be integrated with the polymer fibers. The polymer fibers were selected from fibers, nonwoven fabrics, tubes and films. The chromophore to polymer ratio was selected so as to be dependent on the chromophore used, for example: for Eosin Y, 20% w/w ratio (in water) was used for the master chromophore batch, for Fluorescein, 5% w/w ratio was used for the master chromophore batch. A pure 20 Eosin Y fiber was made and a 4:1 mixture (by weight (or 1:1 by fiber weight)) of Eosin Y and Fluorescein was made.

*Preparation of the fibers:* Fibers made of polypropylene, of polyethylene, nylon, or of a combination thereof were prepared. Eosin Y or fluorescein or a combination of Eosin Y and fluorescein were used as photoactivatable agents. A cross-sectional view of the fibers 25 prepared using one type of polymer is shown in Figure 1B. The polyethylene was made into a 50/50 polyethylene core with a polypropylene sheath. A cross-sectional view of these fibers is shown in Figure 1C.

Fibers having the following composition have been considered:

- 30 A) Polypropylene polymer and 5% Eosin Y,
- B) Polypropylene polymer and 10% Eosin Y,
- C) Polypropylene polymer and 15% Eosin Y,
- D) Polypropylene polymer and 20% Eosin Y,
- E) Polypropylene polymer and 5% Eosin Y

- F) Polypropylene polymer and 10% Fluorescein,
- G) Polypropylene polymer and 15% Eosin Y;
- H) Polypropylene polymer and 20% Eosin Y
- I) Polyethylene polymer and 5% Eosin Y,
- 5 J) Polyethylene polymer and 10% Eosin Y,
- K) Polyethylene polymer and 15% Eosin Y,
- L) Polyethylene polymer and 20% Eosin Y,
- M) Polyethylene polymer and 5% Fluorescein,
- N) Nylon and 5% Eosin Y,
- 10 O) Nylon and 10% Eosin Y,
- P) Nylon and 15% Eosin Y,
- Q) Nylon and 20% Eosin Y,
- R) Nylon and 5% Fluorescein.

15 *Non-woven fabric:* Polypropylene fibers were used as non-woven samples. The following fibers were prepared:

- S) Polypropylene polymer and 0.5g/L Eosin Y,
- T) Polypropylene polymer and 0.5g/L Eosin Y and 0.25g/L fluorescein.

20 *EXAMPLE 2*  
*Preparation of photoactivatable fibers with lubricant*

25 Fibers were dipped in a bath of chromophore and lubricant (1:6 oil:water) (i.e., lurol oil) to produce fibers that were colored and that fluoresced. The fibers incorporated two chromophores, both Eosin Y and a fluorescein/Eosin Y mixture (1/4). The polyethylene was made into a 50/50 polyethylene core with a polypropylene sheath.

Fibers having the following composition have been considered:

- AA)** Polymethyl methacrylate (Sheath) with Polypropylene (Core), Eosin Y:Fluorescein 10g/L each, *150 micron monofilament*,
- BB)** Polymethyl methacrylate (Sheath) with Polypropylene (Core), Eosin Y:Fluorescein 20g/L each, *150 micron monofilament*,
- CC)** Polymethyl methacrylate (Sheath) with Polypropylene (Core), Eosin Y:Fluorescein 30g/L each, *150 micron monofilament*,
- DD)** Nylon, Eosin Y:Fluorescein 10g/L each, *150 micron multifilament*,
- EE)** Nylon, Eosin Y:Fluorescein 20g/L each, *150 micron multifilament*,
- FF)** Nylon, Eosin Y: Fluorescein 50g/L each, *150 micron multifilament*,
- GG)** Polypropylene, Eosin Y Chromophore 20%, 2 pounds,
- HH)** Polypropylene, Eosin Y Chromophore 20%, 1 pounds MIXED WITH polypropylene, Fluorescein Chromophore 5%, 1 pounds (1:1 Ratio)
- 40 Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 1 pound AND polypropylene Core blank, Blank, 1 pound,

II) Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 0.5 pounds MIXED WITH polyethylene Sheath doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio),  
 JJ) Polypropylene Core blank, Blank, 1 pound,  
 5 KK) Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 1 pound AND polypropylene Core doped with, Eosin Y Chromophore 20%, 1 pound,  
 LL) Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 0.5 pounds MIXED WITH polyethylene Sheath doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio) AND polypropylene Core doped with, Eosin Y Chromophore 20%, 1 pound,  
 10 MM) Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 0.5 pounds MIXED WITH polyethylene Sheath doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio) AND polypropylene Core doped with, Eosin Y Chromophore 20%, 0.5 pounds MIXED WITH polypropylene Core doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio),  
 NN) Polyethylene Sheath blank, Blank, 1 pound WITH polypropylene Core doped with, Eosin Y Chromophore 20%, 1 pound,  
 15 OO) Polyethylene Sheath blank, Blank, 1 pound AND polypropylene core doped with, Eosin Y Chromophore 20%, 0.5 pounds MIXED WITH polypropylene core doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio),  
 PP) Polyethylene Sheath doped with, Eosin Y Chromophore 20%, 1 pound AND polypropylene core doped with, Eosin Y Chromophore 20%, 0.5 pound MIXED WITH polypropylene core doped with, Fluorescein Chromophore 5%, 0.5 pounds (1:1 Ratio)  
 20 QQ) Nylon, Eosin Y Chromophore 20%, 2 pounds,  
 RR) Nylon, Eosin Y Chromophore 20%, 1 pound MIXED WITH Nylon, Fluorescein Chromophore 5%, 1 pound (1:1 Ratio).

25 *EXAMPLE 3*  
*Fluorescence emission by photoactivatable fibers*

The photoactivatable fibers outlined in Tables 1, 5, 9, 14, 19 and 25 were prepared; a composition of photoactivatable agents was sprayed onto some of the fibers. Each of these 30 fibers was assessed for its ability to emit fluorescence following illumination for 5mins at 5cm using a Thera<sup>TM</sup> Lamp. The results are presented in Figure 2A (nylon fibers), Figure 2B (PBT fibers) and Figure 2C (PMMA fibers) and in Tables 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32 and 33.

Table 1: Photoactivatable fibers comprising polyethylene compounded with Eosin

| Fiber | Composition   | Fluorescence Emission |
|-------|---|-----------------------|
| 1     | Polyethylene with 0.5% Eosin + Lurol Oil Coating                              | Table 2               |
| 2     | Polyethylene with 0.5% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating   | Table 3               |
| 3     | Polyethylene with 0.5% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 4               |
| 4     | Polyethylene with 0.5% Eosin + 10 g/L Eosin Y Coating + Lurol Oil Coating     | -                     |

Table 2: Fiber 1 - Polyethylene + Eosin Inside, Lurol Oil Outside

| Fiber 1 -<br>Polyethylene + Eosin<br>Inside, Lurol Oil<br>Outside |               | mW/cm <sup>2</sup> at 5 cm |              |             |              |              |             |              |              |             |              |             |                   |            |
|---|---------------|----------------------------|--------------|-------------|--------------|--------------|-------------|--------------|--------------|-------------|--------------|-------------|-------------------|------------|
|   |               | 0                          | 0,5<br>min   | 1<br>min    | 1,5<br>min   | 2<br>min     | 2,5<br>min  | 3<br>min     | 3,5<br>min   | 4<br>min    | 4,5<br>min   | 5<br>min    | J/cm <sup>2</sup> |            |
| Lamp  | 400-<br>518   | 37.7<br>3                  | 37.8<br>3    | 37.8<br>9   | 37.9<br>1    | 38.0<br>4    | 38.1<br>8   | 38.2<br>8    | 38.3<br>6    | 38.4<br>4   | 38.5<br>6    | 38.6<br>1   | 11.4<br>4         | 99.9<br>%  |
| Fluoresc.   | 519-<br>760   | 0.03                       | 0.03         | 0.03        | 0.03         | 0.03         | 0.03        | 0.02         | 0.03         | 0.03        | 0.02         | 0.02        | 0.01              | 0.1<br>%   |
| total   | 400-<br>760   | 37.7<br>6779               | 37.8<br>5432 | 37.9<br>151 | 37.9<br>4457 | 38.0<br>6825 | 38.2<br>112 | 38.3<br>0258 | 38.3<br>8788 | 38.4<br>684 | 38.5<br>8573 | 38.6<br>291 | 11.4<br>5         | 100.<br>0% |
| %fluoresc<br>ence   |               | 0.1<br>%                   | 0.1<br>%     | 0.1<br>%    | 0.1<br>%     | 0.1<br>%     | 0.1<br>%    | 0.1<br>%     | 0.1<br>%     | 0.1<br>%    | 0.0<br>%     | 0.0<br>%    | 0.00              | 0.1<br>%   |
| purple  | (400)-<br>450 | 25.7<br>413                | 25.4<br>023  | 25.1<br>707 | 24.9<br>117  | 24.7<br>605  | 24.6<br>212 | 24.4<br>817  | 24.3<br>537  | 24.2<br>225 | 24.1<br>625  | 24.0<br>604 | 7.43              | 65.0<br>%  |
| Blue  | 450-<br>500   | 11.9<br>843                | 12.4<br>069  | 12.6<br>914 | 12.9<br>768  | 13.2<br>592  | 13.5<br>382 | 13.7<br>734  | 13.9<br>839  | 14.1<br>869 | 14.3<br>716  | 14.5<br>227 | 4.00              | 34.9<br>%  |
| Green   | 500-<br>570   | 0.01<br>17                 | 0.01<br>97   | 0.03<br>07  | 0.02<br>79   | 0.02<br>59   | 0.02<br>67  | 0.03<br>38   | 0.03<br>34   | 0.04<br>15  | 0.03<br>49   | 0.03<br>13  | 0.01              | 0.1<br>%   |
| Yellow  | 570-<br>591   | 0.00<br>65                 | 0.00<br>67   | 0.00<br>92  | 0.01<br>02   | 0.00<br>93   | 0.00<br>92  | 0.00<br>56   | 0.00<br>71   | 0.01<br>08  | 0.00<br>64   | 0.00<br>58  | 0.00              | 0.0<br>%   |
| Orange  | 591-<br>610   | 0.00<br>54                 | 0.00<br>98   | 0.00<br>88  | 0.01<br>10   | 0.00<br>91   | 0.00<br>96  | 0.00<br>64   | 0.00<br>74   | 0.00<br>64  | 0.00<br>72   | 0.00<br>56  | 0.00              | 0.0<br>%   |
| Red   | 610-<br>760   | 0.01<br>88                 | 0.00<br>94   | 0.00<br>47  | 0.00<br>75   | 0.00<br>47   | 0.00<br>68  | 0.00<br>19   | 0.00<br>26   | 0.00<br>05  | 0.00<br>35   | 0.00<br>35  | 0.00              | 0.0<br>%   |
| total   | (400-<br>700) | 37.7<br>7                  | 37.8<br>5    | 37.9<br>2   | 37.9<br>5    | 38.0<br>7    | 38.2<br>1   | 38.3<br>0    | 38.3<br>9    | 38.4<br>7   | 38.5<br>9    | 38.6<br>3   | 11.4<br>5         | 100.<br>0% |

Table 3: Fiber 2 - with Urea Peroxide in Lurol Oil

| Fiber 2 - with Urea<br>Peroxide in Lurol Oil |               | mW/cm <sup>2</sup> at 5 cm |              |              |              |              |              |              |              |              |              |              |                   |               |
|--|---------------|----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------|---------------|
|  |               | 0                          | 0,5<br>min   | 1<br>min     | 1,5<br>min   | 2<br>min     | 2,5<br>min   | 3<br>min     | 3,5<br>min   | 4<br>min     | 4,5<br>min   | 5<br>min     | J/cm <sup>2</sup> |               |
| Lamp   | 400-518       | 44.3<br>4                  | 43.5<br>6    | 43.6<br>0    | 43.5<br>9    | 43.5<br>3    | 43.4<br>8    | 43.4<br>5    | 43.4<br>7    | 43.4<br>8    | 43.6<br>0    | 43.6<br>9    | 13.<br>08         | 99.9<br>%     |
| Fluoresc.                                    | 519-760       | 0.03                       | 0.03         | 0.03         | 0.03         | 0.03         | 0.04         | 0.03         | 0.03         | 0.03         | 0.04         | 0.04         | 0.04              | 0.0<br>1<br>% |
| total  | 400-760       | 44.3<br>64                 | 43.5<br>9121 | 43.6<br>3011 | 43.6<br>2437 | 43.5<br>5596 | 43.5<br>2089 | 43.4<br>8319 | 43.4<br>9531 | 43.5<br>0617 | 43.6<br>3938 | 43.7<br>2855 | 13.<br>09         | 100.<br>0%    |
| %fluoresc<br>ence                            |               | 0.1<br>%                   | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.1<br>%     | 0.0<br>0          | 0.1<br>%      |
| purple                                       | (400)-<br>450 | 28.7<br>823                | 27.7<br>839  | 27.6<br>486  | 27.3<br>997  | 27.1<br>146  | 26.9<br>311  | 26.7<br>372  | 26.5<br>918  | 26.4<br>659  | 26.4<br>030  | 26.3<br>381  | 8.1<br>6          | 62.3<br>%     |
| Blue   | 450-500       | 15.5<br>221                | 15.7<br>414  | 15.9<br>171  | 16.1<br>574  | 16.3<br>843  | 16.5<br>173  | 16.6<br>797  | 16.8<br>401  | 16.9<br>717  | 17.1<br>625  | 17.3<br>136  | 4.9<br>2          | 37.6<br>%     |
| Green  | 500-570       | 0.03<br>76                 | 0.04<br>15   | 0.03<br>69   | 0.04<br>31   | 0.03<br>08   | 0.04<br>36   | 0.03<br>89   | 0.03<br>93   | 0.04<br>06   | 0.05<br>04   | 0.04<br>74   | 0.0<br>1          | 0.1<br>%      |
| Yellow                                       | 570-591       | 0.00<br>91                 | 0.00<br>94   | 0.01<br>12   | 0.00<br>94   | 0.00<br>83   | 0.01<br>11   | 0.00<br>72   | 0.00<br>93   | 0.00<br>83   | 0.01<br>15   | 0.00<br>76   | 0.0<br>0          | 0.0<br>%      |
| Orange                                       | 591-610       | 0.00<br>76                 | 0.00<br>87   | 0.01<br>06   | 0.01<br>03   | 0.00<br>99   | 0.01<br>11   | 0.01<br>07   | 0.01<br>00   | 0.01<br>07   | 0.00<br>92   | 0.01<br>14   | 0.0<br>0          | 0.0<br>%      |
| Red  | 610-760       | 0.00<br>55                 | 0.00<br>69   | 0.00<br>60   | 0.00<br>49   | 0.00<br>85   | 0.00<br>72   | 0.01<br>01   | 0.00<br>51   | 0.00<br>96   | 0.00<br>31   | 0.01<br>10   | 0.0<br>0          | 0.0<br>%      |
| total  | (400-<br>700) | 44.3<br>6                  | 43.5<br>9    | 43.6<br>3    | 43.6<br>2    | 43.5<br>6    | 43.5<br>2    | 43.4<br>8    | 43.5<br>0    | 43.5<br>1    | 43.6<br>4    | 43.7<br>3    | 13.<br>09         | 100.<br>0%    |

Table 4: Fiber 3 - with Sodium Bicarbonate in Lurol Oil

| Fiber 3- with Sodium Bicarbonate in Lurol Oil |           | mW/cm2 at 5 cm |         |          |          |          |          |          |         |          |         |          |        |        |
|---|-----------|----------------|---------|----------|----------|----------|----------|----------|---------|----------|---------|----------|--------|--------|
|   |           | 0              | 0,5 min | 1 min    | 1,5 min  | 2 min    | 2,5 min  | 3 min    | 3,5 min | 4 min    | 4,5 min | 5 min    | J/c m2 |        |
| Lamp  | 400-518   | 45.77          | 45.38   | 45.39    | 45.41    | 45.38    | 45.46    | 45.53    | 45.55   | 45.53    | 45.53   | 45.64    | 13.65  | 99.9%  |
| Fluoresc.                                     | 519-760   | 0.03           | 0.03    | 0.03     | 0.02     | 0.03     | 0.03     | 0.02     | 0.03    | 0.04     | 0.02    | 0.03     | 0.0    | 0.1%   |
| total   | 400-760   | 45.79708       | 45.4078 | 45.42176 | 45.43369 | 45.40676 | 45.48801 | 45.55223 | 45.58   | 45.56858 | 45.554  | 45.66506 | 13.66  | 100.0% |
| %fluorescence                                 |           | 0.1%           | 0.1%    | 0.1%     | 0.0%     | 0.1%     | 0.1%     | 0.0%     | 0.1%    | 0.1%     | 0.1%    | 0.1%     | 0.0    | 0.1%   |
| purple  | (400)-450 | 30.4595        | 29.6024 | 29.2516  | 28.8436  | 28.6273  | 28.4034  | 28.2416  | 28.0332 | 27.8598  | 27.6870 | 27.6032  | 8.61   | 63.0%  |
| Blue  | 450-500   | 15.2759        | 15.7454 | 16.1074  | 16.5308  | 16.7115  | 17.0158  | 17.2490  | 17.4738 | 17.6294  | 17.7953 | 17.7823  | 5.03   | 36.8%  |
| Green   | 500-570   | 0.0356         | 0.0341  | 0.0350   | 0.0419   | 0.0480   | 0.0437   | 0.0514   | 0.0500  | 0.0491   | 0.0580  | 0.0545   | 0.01   | 0.1%   |
| Yellow  | 570-591   | 0.0075         | 0.0081  | 0.0062   | 0.0067   | 0.0080   | 0.0068   | 0.0031   | 0.0094  | 0.0000   | 0.0052  | 0.0053   | 0.000  | 0.0%   |
| Orange  | 591-610   | 0.0107         | 0.0106  | 0.0104   | 0.0063   | 0.0071   | 0.0089   | 0.0040   | 0.0090  | 0.0116   | 0.0060  | 0.0060   | 0.000  | 0.0%   |
| Red   | 610-760   | 0.0082         | 0.0076  | 0.0117   | 0.0146   | 0.0051   | 0.0098   | 0.0035   | 0.0049  | 0.0091   | 0.0026  | 0.0041   | 0.000  | 0.0%   |
| total   | (400-700) | 45.80          | 45.41   | 45.42    | 45.43    | 45.41    | 45.49    | 45.55    | 45.58   | 45.57    | 45.55   | 45.67    | 13.66  | 100.0% |

Table 5: Photoactivatable fibers comprising polylactic acid (PLA) compounded with Eosin

| Fiber | Composition  | Fluorescence Emission |
|-------|--|-----------------------|
| 5     | PLA with 0.5% Eosin + Lurol Oil Coating                              | Table 6               |
| 6     | PLA with 0.5% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating   | Table 7               |
| 7     | PLA with 0.5% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 8               |

Table 6: Fiber 5 - Polylactic Acid + Eosin Inside, Lurol Oil Outside

| Fiber 5 - Polylactic Acid + Eosin Inside, Lurol Oil Outside |           | mW/cm2 at 5 cm |          |          |          |         |          |          |          |          |          |          |        |       |
|---|-----------|----------------|----------|----------|----------|---------|----------|----------|----------|----------|----------|----------|--------|-------|
|   |           | 0              | 0,5 min  | 1 min    | 1,5 min  | 2 min   | 2,5 min  | 3 min    | 3,5 min  | 4 min    | 4,5 min  | 5 min    | J/c m2 |       |
| Lamp  | 400-518   | 14.94          | 14.93    | 14.85    | 14.75    | 14.71   | 14.67    | 14.65    | 14.66    | 14.62    | 14.61    | 14.61    | 4.42   | 93.9% |
| Fluoresc.   | 519-760   | 1.12           | 1.02     | 0.98     | 0.95     | 0.94    | 0.92     | 0.91     | 0.90     | 0.87     | 0.87     | 0.85     | 0.28   | 6.0%  |
| total   | 400-760   | 16.05383       | 15.94828 | 15.82929 | 15.69884 | 15.6478 | 15.58449 | 15.56786 | 15.55919 | 15.48759 | 15.48833 | 15.46502 | 4.71   | 99.9% |
| %fluorescence   |           | 6.46.9%        | 6.2%     | 6.1%     | 6.0%     | 5.9%    | 5.9%     | 5.8%     | 5.6%     | 5.6%     | 5.5%     | 5.5%     | 0.06   | 6.0%  |
| purple  | (400)-450 | 10.4182        | 10.2214  | 10.0756  | 9.9133   | 9.8031  | 9.7045   | 9.6358   | 9.5792   | 9.5010   | 9.4528   | 9.4132   | 2.95   | 62.6% |
| Blue  | 450-500   | 4.5199         | 4.7079   | 4.7777   | 4.8335   | 4.9048  | 4.9608   | 5.0190   | 5.0769   | 5.1140   | 5.1618   | 5.1980   | 1.47   | 31.3% |

|               |                  |        |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                        |                         |          |
|---------------|------------------|--------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------------|-------------------------|----------|
| <b>Green</b>  | <b>500-570</b>   | 0.1184 | 0.11<br>03        | 0.10<br>17        | 0.09<br>82        | 0.09<br>79        | 0.09<br>45        | 0.09<br>47        | 0.09<br>31        | 0.09<br>08        | 0.09<br>13        | 0.09<br>90        | 0.08<br>3              | <b>0.0</b><br><b>3</b>  | 0.6<br>% |
| <b>Yellow</b> | <b>570-591</b>   | 0.2998 | 0.28<br>48        | 0.27<br>31        | 0.26<br>68        | 0.26<br>31        | 0.25<br>78        | 0.25<br>61        | 0.25<br>23        | 0.24<br>61        | 0.24<br>36        | 0.23<br>86        | <b>0.0</b><br><b>8</b> | 1.7<br>%                |          |
| <b>Orange</b> | <b>591-610</b>   | 0.3337 | 0.31<br>19        | 0.30<br>02        | 0.29<br>39        | 0.28<br>91        | 0.28<br>39        | 0.28<br>06        | 0.27<br>80        | 0.27<br>00        | 0.26<br>88        | 0.26<br>26        | <b>0.0</b><br><b>9</b> | 1.9<br>%                |          |
| <b>Red</b>    | <b>610-760</b>   | 0.3793 | 0.32<br>65        | 0.31<br>52        | 0.30<br>70        | 0.30<br>35        | 0.29<br>65        | 0.29<br>49        | 0.29<br>29        | 0.28<br>84        | 0.27<br>28        | 0.27<br>61        | <b>0.0</b><br><b>9</b> | 2.0<br>%                |          |
| <b>total</b>  | <b>(400-700)</b> | 16.07  | <b>15.9<br/>6</b> | <b>15.8<br/>4</b> | <b>15.7<br/>1</b> | <b>15.6<br/>6</b> | <b>15.6<br/>0</b> | <b>15.5<br/>8</b> | <b>15.5<br/>7</b> | <b>15.5<br/>0</b> | <b>15.5<br/>0</b> | <b>15.4<br/>8</b> | <b>4.7<br/>1</b>       | <b>100<br/>.0<br/>%</b> |          |

Table 7: Fiber 6 - Polylactic Acid + Eosin Inside, UP + Lurol Oil Outside

| Fiber 6 - Polylactic Acid + Eosin Inside, UP + Lurol Oil Outside |                  | mW/cm2 at 5 cm       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                     |             |            |
|--|------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|-------------|------------|
|  |                  | 0                    | 0,5 min              | 1 min                | 1,5 min              | 2 min                | 2,5 min              | 3 min                | 3,5 min              | 4 min                | 4,5 min              | 5 min               | J/cm2       |            |
| <b>Lamp</b>  | <b>400-518</b>   | 15.2<br>7            | 15.3<br>2            | 15.3<br>3            | 15.3<br>1            | 15.2<br>9            | 15.2<br>8            | 15.2<br>6            | 15.2<br>2            | 15.1<br>8            | 15.1<br>4            | 15.1<br>1           | <b>4.58</b> | 94.4<br>%  |
| <b>Fluoresc.</b>   | <b>519-760</b>   | 1.05                 | 0.94                 | 0.91                 | 0.90                 | 0.89                 | 0.86                 | 0.85                 | 0.83                 | 0.83                 | 0.80                 | 0.79                | <b>0.27</b> | 5.5<br>%   |
| <b>total</b>   | <b>400-760</b>   | <b>16.3<br/>2258</b> | <b>16.2<br/>6344</b> | <b>16.2<br/>4112</b> | <b>16.2<br/>0668</b> | <b>16.1<br/>7224</b> | <b>16.1<br/>4035</b> | <b>16.1<br/>0769</b> | <b>16.0<br/>5246</b> | <b>16.0<br/>0419</b> | <b>15.9<br/>4197</b> | <b>15.8<br/>982</b> | <b>4.84</b> | 99.9<br>%  |
| <b>%fluorescence</b>   |                  | 6.4<br>%             | 5.8<br>%             | 5.6<br>%             | 5.6<br>%             | 5.5<br>%             | 5.3<br>%             | 5.3<br>%             | 5.2<br>%             | 5.2<br>%             | 5.0<br>%             | 5.0<br>%            | <b>0.05</b> | 5.5<br>%   |
| <b>purple</b>  | <b>(400)-450</b> | 10.6<br>935          | 10.4<br>773          | 10.3<br>672          | 10.2<br>573          | 10.1<br>656          | 10.0<br>862          | 10.0<br>081          | 9.92<br>36           | 9.84<br>64           | 9.77<br>68           | 9.70<br>92          | <b>3.05</b> | 62.9<br>%  |
| <b>Blue</b>  | <b>450-500</b>   | 4.57<br>88           | 4.84<br>58           | 4.96<br>28           | 5.04<br>82           | 5.12<br>15           | 5.19<br>21           | 5.24<br>99           | 5.29<br>48           | 5.33<br>11           | 5.36<br>29           | 5.39<br>90          | <b>1.53</b> | 31.6<br>%  |
| <b>Green</b>   | <b>500-570</b>   | 0.09<br>72           | 0.08<br>53           | 0.08<br>22           | 0.08<br>26           | 0.07<br>97           | 0.07<br>87           | 0.07<br>78           | 0.07<br>52           | 0.07<br>41           | 0.07<br>37           | 0.07<br>02          |             | 0.5<br>%   |
| <b>Yellow</b>  | <b>570-591</b>   | 0.29<br>06           | 0.25<br>67           | 0.24<br>70           | 0.24<br>36           | 0.23<br>80           | 0.23<br>30           | 0.22<br>87           | 0.22<br>54           | 0.22<br>23           | 0.21<br>62           | 0.21<br>32          | <b>0.07</b> | 1.5<br>%   |
| <b>Orange</b>  | <b>591-610</b>   | 0.32<br>65           | 0.29<br>30           | 0.28<br>36           | 0.27<br>86           | 0.27<br>26           | 0.26<br>64           | 0.26<br>18           | 0.25<br>78           | 0.25<br>49           | 0.24<br>74           | 0.24<br>33          | <b>0.08</b> | 1.7<br>%   |
| <b>Red</b>   | <b>610-760</b>   | 0.35<br>16           | 0.31<br>93           | 0.31<br>21           | 0.30<br>97           | 0.30<br>79           | 0.29<br>68           | 0.29<br>42           | 0.28<br>80           | 0.28<br>66           | 0.27<br>64           | 0.27<br>15          | <b>0.09</b> | 1.9<br>%   |
| <b>total</b>   | <b>(400-700)</b> | <b>16.3<br/>4</b>    | <b>16.2<br/>8</b>    | <b>16.2<br/>5</b>    | <b>16.2<br/>2</b>    | <b>16.1<br/>9</b>    | <b>16.1<br/>5</b>    | <b>16.1<br/>2</b>    | <b>16.0<br/>6</b>    | <b>16.0<br/>2</b>    | <b>15.9<br/>5</b>    | <b>15.9<br/>1</b>   | <b>4.85</b> | 100.<br>0% |

Table 8: Fiber 7 - Polylactic Acid + Eosin Inside, Bicarb + Lurol Oil Outside

| Fiber 7 - Polylactic Acid + Eosin Inside, Bicarb + Lurol Oil Outside |                | mW/cm2 at 5 cm |           |           |           |           |           |           |           |           |           |           |             |                |
|--|----------------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|----------------|
|  |                | 0              | 0,5 min   | 1 min     | 1,5 min   | 2 min     | 2,5 min   | 3 min     | 3,5 min   | 4 min     | 4,5 min   | 5 min     | J/cm2       |                |
| <b>Lamp</b>  | <b>400-518</b> | 16.07<br>4     | 16.0<br>1 | 16.0<br>0 | 15.9<br>9 | 15.7<br>7 | 15.7<br>2 | 15.6<br>6 | 15.6<br>5 | 15.6<br>0 | 15.7<br>5 | 15.7<br>5 | <b>4.75</b> | 94.<br>.3<br>% |
| <b>Fluoresc.</b>   | <b>519-760</b> | 1.12           | 0.99      | 0.96      | 0.93      | 0.92      | 0.92      | 0.91      | 0.89      | 0.87      | 0.87      | 0.84      | <b>0.28</b> | 5.<br>6<br>%   |

|                      |                  |                     |                     |                     |                     |                     |                     |                     |                     |                    |                     |                     |             |            |
|----------------------|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|---------------------|---------------------|-------------|------------|
| <b>total</b>         | 400-760          | <b>17.189</b><br>91 | <b>17.0</b><br>3564 | <b>16.9</b><br>6755 | <b>16.8</b><br>3133 | <b>16.7</b><br>1217 | <b>16.6</b><br>9256 | <b>16.6</b><br>2935 | <b>16.5</b><br>5821 | <b>16.5</b><br>202 | <b>16.5</b><br>6995 | <b>16.5</b><br>9658 | <b>5.03</b> | 99.9%<br>% |
| <b>%fluorescence</b> |                  | 6.5%                | 5.8%<br>%           | 5.7%<br>%           | 5.5%<br>%           | 5.5%<br>%           | 5.4%<br>%           | 5.4%<br>%           | 5.2%<br>%           | 5.2%<br>%          | 5.1%<br>%           | <b>0.06</b>         | 5.6%<br>%   |            |
| <b>purple</b>        | <b>(400)-450</b> | 11.170<br>5         | 10.9<br>276         | 10.8<br>025         | 10.6<br>200         | 10.4<br>800         | 10.3<br>930         | 10.2<br>891         | 10.1<br>908         | 10.1<br>298        | 10.1<br>080         | 10.0<br>959         | <b>3.15</b> | 62.6%<br>% |
| <b>Blue</b>          | <b>450-500</b>   | 4.9016              | 5.11<br>69          | 5.20<br>34          | 5.27<br>92          | 5.31<br>12          | 5.38<br>11          | 5.43<br>51          | 5.47<br>30          | 5.52<br>52         | 5.59<br>22          | 5.65<br>75          | <b>1.60</b> | 31.7%<br>% |
| <b>Green</b>         | <b>500-570</b>   | 0.1197              | 0.10<br>19          | 0.09<br>51          | 0.09<br>32          | 0.09<br>13          | 0.09<br>29          | 0.09<br>18          | 0.08<br>94          | 0.08<br>59         | 0.08<br>90          | 0.08<br>58          | <b>0.03</b> | 0.6%<br>%  |
| <b>Yellow</b>        | <b>570-591</b>   | 0.3141              | 0.27<br>30          | 0.26<br>62          | 0.25<br>85          | 0.25<br>57          | 0.25<br>32          | 0.24<br>95          | 0.24<br>54          | 0.23<br>82         | 0.23<br>81          | 0.23<br>13          | <b>0.08</b> | 1.5%<br>%  |
| <b>Orange</b>        | <b>591-610</b>   | 0.3475              | 0.30<br>54          | 0.29<br>67          | 0.28<br>81          | 0.28<br>47          | 0.28<br>17          | 0.27<br>78          | 0.27<br>40          | 0.26<br>70         | 0.26<br>55          | 0.25<br>86          | <b>0.09</b> | 1.7%<br>%  |
| <b>Red</b>           | <b>610-760</b>   | 0.3529              | 0.32<br>53          | 0.31<br>78          | 0.30<br>62          | 0.30<br>28          | 0.30<br>42          | 0.29<br>94          | 0.29<br>88          | 0.28<br>68         | 0.28<br>98          | 0.27<br>99          | <b>0.09</b> | 1.8%<br>%  |
| <b>total</b>         | <b>(400-700)</b> | <b>17.21</b>        | <b>17.0</b><br>5    | <b>16.9</b><br>8    | <b>16.8</b><br>5    | <b>16.7</b><br>3    | <b>16.7</b><br>1    | <b>16.6</b><br>4    | <b>16.5</b><br>7    | <b>16.5</b><br>3   | <b>16.5</b><br>8    | <b>16.6</b><br>1    | <b>5.04</b> | 10.0%<br>% |

Table 9: Photoactivatable fibers comprising polypropylene compounded with Eosin

| <b>Fiber</b> | <b>Composition</b>   | <b>Fluorescence Emission</b> |
|--------------|--|------------------------------|
| 8            | Polypropylene with 0.5% Eosin + Lurol Oil Coating                              | Table 10                     |
| 9            | Polypropylene with 0.5% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating   | Table 11                     |
| 10           | Polypropylene with 0.5% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 12                     |
| 11           | Polypropylene with 0.5% Eosin + 10 g/L Eosin Y Coating + Lurol Oil Coating     | Table 13                     |

Table 10: Fiber 8 - Polypropylene + Eosin Inside, Lurol Oil Outside

| Fiber 8 - Polypropylene + Eosin Inside, Lurol Oil |                | mW/cm2 at 5 cm |              |              |              |              |              |              |              |              |              |             |              | J/c m2     |
|---|----------------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|--------------|------------|
|   |                | 0              | 0,5 min      | 1 min        | 1,5 min      | 2 min        | 2,5 min      | 3 min        | 3,5 min      | 4 min        | 4,5 min      | 5 min       |              |            |
| Lamp  | <b>400-518</b> | 38.7<br>9      | 38.5<br>0    | 38.3<br>1    | 38.1<br>1    | 37.9<br>1    | 37.6<br>0    | 37.3<br>7    | 37.2<br>3    | 36.9<br>8    | 36.8<br>9    | 36.7<br>0   | <b>11.33</b> | 99.9%<br>% |
| Fluoresc.   | <b>519-760</b> | 0.10           | 0.01         | 0.01         | 0.01         | 0.01         | 0.01         | 0.01         | 0.01         | 0.01         | 0.02         | 0.02        | <b>0.01</b>  | 0.1%<br>%  |
| total   | <b>400-760</b> | 38.8<br>87     | 38.5<br>1682 | 38.3<br>1451 | 38.1<br>1967 | 37.9<br>1618 | 37.6<br>0603 | 37.3<br>7597 | 37.2<br>4258 | 36.9<br>9724 | 36.9<br>0971 | 36.7<br>173 | <b>11.34</b> | 10.0%<br>% |
| %fluorescence                                     |                | 0.2%<br>%      | 0.0%<br>%    | 0.1%<br>%    | 0.1%<br>%   | <b>0.00</b>  | 0.1%<br>%  |

|               |                  |              |              |              |              |              |              |              |              |              |              |              |                        |                        |
|---------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------------------|------------------------|
| <b>purple</b> | <b>(400)-450</b> | 26.2<br>13   | 25.6<br>104  | 25.2<br>140  | 24.8<br>144  | 24.4<br>722  | 24.0<br>801  | 23.7<br>486  | 23.5<br>275  | 23.2<br>268  | 23.0<br>455  | 22.8<br>148  | <b>7.3</b><br><b>2</b> | 64.6<br>%<br>%         |
| <b>Blue</b>   | <b>450-500</b>   | 12.5<br>66.2 | 12.8<br>714  | 13.0<br>711  | 13.2<br>695  | 13.4<br>083  | 13.4<br>929  | 13.5<br>901  | 13.6<br>822  | 13.7<br>305  | 13.8<br>151  | 13.8<br>517  | <b>4.0</b><br><b>0</b> | 35.3<br>%<br>%         |
| <b>Green</b>  | <b>500-570</b>   | 0.01<br>01   | 0.02<br>23   | 0.02<br>21   | 0.02<br>49   | 0.02<br>89   | 0.02<br>53   | 0.02<br>93   | 0.02<br>57   | 0.02<br>72   | 0.03<br>45   | 0.03<br>39   | <b>0.0</b><br><b>1</b> | 0.1<br>%<br>%          |
| <b>Yellow</b> | <b>570-591</b>   | 0.00<br>02   | 0.00<br>03   | 0.00<br>06   | 0.00<br>53   | 0.00<br>14   | 0.00<br>36   | 0.00<br>21   | 0.00<br>10   | 0.00<br>23   | 0.00<br>53   | 0.00<br>30   | <b>0.0</b><br><b>0</b> | 0.0<br>%<br>%          |
| <b>Orange</b> | <b>591-610</b>   | 0.00<br>00   | 0.00<br>29   | 0.00<br>44   | 0.00<br>49   | 0.00<br>26   | 0.00<br>31   | 0.00<br>30   | 0.00<br>33   | 0.00<br>45   | 0.00<br>32   | 0.00<br>54   | <b>0.0</b><br><b>0</b> | 0.0<br>%<br>%          |
| <b>Red</b>    | <b>610-760</b>   | 0.09<br>09   | 0.00<br>96   | 0.00<br>26   | 0.00<br>08   | 0.00<br>29   | 0.00<br>12   | 0.00<br>29   | 0.00<br>29   | 0.00<br>61   | 0.00<br>60   | 0.00<br>87   | <b>0.0</b><br><b>0</b> | 0.0<br>%<br>%          |
| <b>total</b>  | <b>(400-700)</b> | <b>38.89</b> | <b>38.52</b> | <b>38.31</b> | <b>38.12</b> | <b>37.92</b> | <b>37.61</b> | <b>37.38</b> | <b>37.24</b> | <b>37.00</b> | <b>36.91</b> | <b>36.72</b> | <b>11.34</b>           | <b>10.0%</b><br>%<br>% |

Table 11: Fiber 9 - Polypropylene + Eosin Inside, UP + Lurol Oil Outside

| Fiber 9 - Polypropylene + Eosin Inside, UP + Lurol Oil Outside |                  | mW/cm <sup>2</sup> at 5 cm |                |                |                |                |                |               |              |              |              |              |              | J/cm   |
|--|------------------|----------------------------|----------------|----------------|----------------|----------------|----------------|---------------|--------------|--------------|--------------|--------------|--------------|--------|
|  |                  | 0                          | 0,5 mi         | 1 min          | 1,5 min        | 2 mi           | 2,5 min        | 3 min         | 3,5 min      | 4 min        | 4,5 min      | 5 min        |              |        |
| <b>Lamp</b>  | <b>400-518</b>   | 38.22                      | 37.85          | 37.66          | 37.36          | 37.11          | 36.88          | 36.72         | 36.64        | 36.51        | 36.43        | 36.37        | <b>11.14</b> | 99.9%  |
| <b>Fluoresc.</b>   | <b>519-760</b>   | 0.12                       | 0.00           | 0.02           | 0.00           | 0.01           | 0.01           | 0.02          | 0.01         | 0.01         | 0.01         | 0.01         | <b>0.01</b>  | 0.1%   |
| <b>total</b>   | <b>400-760</b>   | <b>38.33982</b>            | <b>37.8572</b> | <b>37.6763</b> | <b>37.3618</b> | <b>37.1219</b> | <b>36.8930</b> | <b>36.758</b> | <b>36.67</b> | <b>36.55</b> | <b>36.48</b> | <b>36.35</b> | <b>11.5</b>  | 100.0% |
| <b>%fluorescence</b>   |                  | 0.3%                       | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%          | 0.0%         | 0.0%         | 0.0%         | 0.0%         | <b>0.00</b>  | 0.1%   |
| <b>purple</b>  | <b>(400)-450</b> | 25.9945                    | 25.2982        | 24.9107        | 24.4318        | 24.0608        | 23.7143        | 23.4416       | 23.2361      | 23.0084      | 22.8281      | 22.6777      | <b>7.23</b>  | 64.8%  |
| <b>Blue</b>  | <b>450-500</b>   | 12.2258                    | 12.535         | 12.7280        | 12.9008        | 13.030         | 13.1446        | 13.2552       | 13.3760      | 13.4809      | 13.5761      | 13.6610      | <b>3.91</b>  | 35.1%  |
| <b>Green</b>   | <b>500-570</b>   | 0.0032                     | 0.0220         | 0.0210         | 0.0265         | 0.0273         | 0.0230         | 0.0278        | 0.0285       | 0.0241       | 0.0321       | 0.0306       | <b>0.01</b>  | 0.1%   |
| <b>Yellow</b>  | <b>570-591</b>   | 0.0007                     | 0.0001         | 0.0038         | 0.0005         | 0.0004         | 0.0048         | 0.0034        | 0.0005       | 0.0029       | 0.0011       | 0.0009       | <b>0.00</b>  | 0.0%   |
| <b>Orange</b>  | <b>591-610</b>   | 0.0005                     | 0.0003         | 0.0053         | 0.0021         | 0.00014        | 0.0052         | 0.0048        | 0.0033       | 0.0033       | 0.0025       | 0.0023       | <b>0.00</b>  | 0.0%   |
| <b>Red</b>   | <b>610-760</b>   | 0.1152                     | 0.0014         | 0.0078         | 0.0002         | 0.00014        | 0.0014         | 0.0062        | 0.0048       | 0.0020       | 0.0019       | 0.0017       | <b>0.00</b>  | 0.0%   |
| <b>total</b>   | <b>(400-700)</b> | <b>38.34</b>               | <b>37.86</b>   | <b>37.68</b>   | <b>37.36</b>   | <b>37.12</b>   | <b>36.89</b>   | <b>36.74</b>  | <b>36.65</b> | <b>36.52</b> | <b>36.44</b> | <b>36.37</b> | <b>11.5</b>  | 100.0% |

Table 12: Fiber 10 - Polypropylene + Eosin Inside, Bicarb + Lurol Oil Outside

| Fiber 10 - Polypropylene + Eosin Inside, Bicarb + Lurol Oil |           | mW/cm2 at 5 cm |         |        |         |        |         |        |         |        |         |        | J/cm2  |        |
|---|-----------|----------------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|--------|--------|
|   |           | 0              | 0,5 min | 1 min  | 1,5 min | 2 min  | 2,5 min | 3 min  | 3,5 min | 4 min  | 4,5 min | 5 min  |        |        |
| Lamp  | 400-518   | 36.92          | 36.59   | 36.47  | 36.29   | 36.17  | 36.04   | 35.91  | 35.83   | 35.76  | 35.70   | 35.67  | 10.5   | 100.0% |
| Fluoresc.   | 519-760   | 0.00           | 0.01    | 0.01   | 0.01    | 0.01   | 0.01    | 0.01   | 0.01    | 0.01   | 0.01    | 0.01   | 0.00   | 0.00%  |
| total   | 400-760   | 36.922         | 36.594  | 36.478 | 36.300  | 36.183 | 36.047  | 35.916 | 35.842  | 35.770 | 35.708  | 35.674 | 35.5   | 100.0% |
| %fluorescence   |           | 0.0%           | 0.0%    | 0.0%   | 0.0%    | 0.0%   | 0.0%    | 0.0%   | 0.0%    | 0.0%   | 0.0%    | 0.0%   | 0.00   | 0.00%  |
| purple  | (400)-450 | 24.956         | 24.343  | 24.040 | 23.697  | 23.406 | 23.152  | 22.899 | 22.708  | 22.530 | 22.373  | 22.260 | 22.102 | 64.7%  |
| Blue  | 450-500   | 11.941         | 12.226  | 12.407 | 12.572  | 12.743 | 12.860  | 12.985 | 12.101  | 12.204 | 12.300  | 12.383 | 12.32  | 35.2%  |
| Green   | 500-570   | 0.0226         | 0.0177  | 0.0253 | 0.0257  | 0.0262 | 0.0254  | 0.0258 | 0.0244  | 0.0253 | 0.0297  | 0.0281 | 0.021  | 0.1%   |
| Yellow  | 570-591   | 0.0012         | 0.0030  | 0.0017 | 0.0041  | 0.0026 | 0.0015  | 0.0031 | 0.0012  | 0.0039 | 0.0036  | 0.0006 | 0.00   | 0.00%  |
| Orange  | 591-610   | 0.0010         | 0.0035  | 0.0012 | 0.0015  | 0.0027 | 0.0031  | 0.0023 | 0.0031  | 0.0046 | 0.0013  | 0.0012 | 0.00   | 0.00%  |
| Red   | 610-760   | 0.0001         | 0.0015  | 0.0022 | 0.0002  | 0.0014 | 0.0043  | 0.0004 | 0.0033  | 0.0024 | 0.0000  | 0.0015 | 0.00   | 0.00%  |
| total   | (400-700) | 36.92          | 36.60   | 36.48  | 36.30   | 36.18  | 36.05   | 35.92  | 35.84   | 35.77  | 35.71   | 35.67  | 10.5   | 100.0% |

Table 13: Fiber 11 - Polypropylene + Eosin Inside, Eosin + Lurol Oil Outside

| Fiber 11 - Polypropylene + Eosin Inside, Eosin + Lurol Oil Outside |           | mW/cm2 at 5 cm |         |         |         |         |         |         |         |         |         |         | J/cm2  |        |
|--|-----------|----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|--------|
|  |           | 0              | 0,5 min | 1 min   | 1,5 min | 2 min   | 2,5 min | 3 min   | 3,5 min | 4 min   | 4,5 min | 5 min   |        |        |
| Lamp   | 400-518   | 34.92          | 34.27   | 34.10   | 33.96   | 33.80   | 33.65   | 33.52   | 33.43   | 33.36   | 33.23   | 33.16   | 10.5   | 99.9%  |
| Fluoresc.  | 519-760   | 0.04           | 0.02    | 0.03    | 0.03    | 0.03    | 0.03    | 0.03    | 0.03    | 0.03    | 0.03    | 0.03    | 0.01   | 0.1%   |
| total  | 400-760   | 34.960         | 34.2904 | 34.1232 | 33.9897 | 33.8317 | 33.6776 | 33.5548 | 33.4552 | 33.3887 | 33.2601 | 33.1878 | 33.16  | 100.0% |
| %fluorescence  |           | 0.1%           | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.1%    | 0.00   | 0.1%   |
| purple   | (400)-450 | 24.0092        | 23.0633 | 22.6970 | 22.3805 | 22.0694 | 21.8103 | 21.5672 | 21.3650 | 21.1855 | 20.9851 | 20.8562 | 20.863 | 65.3%  |
| Blue   | 450-500   | 10.9008        | 11.1891 | 11.3868 | 11.5594 | 11.7112 | 11.8201 | 11.9385 | 12.0429 | 12.1567 | 12.2284 | 12.2886 | 12.251 | 34.5%  |
| Green  | 500-570   | 0.0173         | 0.0173  | 0.0143  | 0.0107  | 0.0223  | 0.0225  | 0.0194  | 0.0232  | 0.0196  | 0.0235  | 0.0199  | 0.0201 | 0.1%   |

|        |                |              |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                         |                          |
|--------|----------------|--------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------------|--------------------------|
| Yellow | <b>570-591</b> | 0.0118       | 0.00<br>90        | 0.00<br>71        | 0.00<br>88        | 0.00<br>95        | 0.01<br>02        | 0.00<br>76        | 0.00<br>79        | 0.00<br>79        | 0.00<br>75        | 0.00<br>85        | <b>0.<br/>00</b>        | 0.0<br>%                 |
| Orange | <b>591-610</b> | 0.0114       | 0.00<br>76        | 0.00<br>97        | 0.01<br>12        | 0.01<br>04        | 0.00<br>78        | 0.01<br>09        | 0.00<br>81        | 0.00<br>96        | 0.00<br>79        | 0.00<br>85        | <b>0.<br/>00</b>        | 0.0<br>%                 |
| Red    | <b>610-760</b> | 0.0102       | 0.00<br>44        | 0.00<br>88        | 0.00<br>97        | 0.00<br>95        | 0.00<br>69        | 0.01<br>17        | 0.00<br>82        | 0.00<br>98        | 0.00<br>81        | 0.00<br>65        | <b>0.<br/>00</b>        | 0.0<br>%                 |
| total  | (400-700)      | <b>34.96</b> | <b>34.2<br/>9</b> | <b>34.1<br/>2</b> | <b>33.9<br/>9</b> | <b>33.8<br/>3</b> | <b>33.6<br/>8</b> | <b>33.5<br/>6</b> | <b>33.4<br/>6</b> | <b>33.3<br/>9</b> | <b>33.2<br/>6</b> | <b>33.1<br/>9</b> | <b>10.<br/>1<br/>.6</b> | <b>100.<br/>.0<br/>%</b> |

Table 14: Photoactivatable fibers comprising nylon compounded with Eosin

| Fiber | Composition  | Fluorescence Emission |
|-------|--|-----------------------|
| 12    | Nylon with 0.5% Eosin + Lurol Oil Coating                              | Table 15              |
| 13    | Nylon with 0.5% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating   | Table 16              |
| 14    | Nylon with 0.5% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 17              |
| 15    | Nylon with 0.5% Eosin + 10 g/L Eosin Y Coating + Lurol Oil Coating     | Table 18              |

5 Table 15: Fiber 12 - Nylon + Eosin Inside, Lurol Oil Outside

| Fiber 12 - Nylon + Eosin Inside, Lurol Oil Outside |                | mW/cm <sup>2</sup> at 5 cm |                     |                     |                     |                     |                     |                     |                     |                     |                     |                     |                  | J/c<br>m <sup>2</sup> |
|--|----------------|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------------|-----------------------|
|  |                | 0                          | 0,5<br>min          | 1<br>min            | 1,5<br>min          | 2<br>min            | 2,5<br>min          | 3<br>min            | 3,5<br>min          | 4<br>min            | 4,5<br>min          | 5<br>min            |                  |                       |
| Lamp   | <b>400-518</b> | 8.45                       | 9.13                | 10.3<br>4           | 11.3<br>8           | 12.2<br>4           | 13.0<br>6           | 13.8<br>3           | 14.5<br>2           | 15.2<br>4           | 15.8<br>2           | 16.3<br>8           | <b>3.7<br/>2</b> | 69.<br>9%             |
| Fluoresc.  | <b>519-760</b> | 7.55                       | 6.46                | 5.97                | 5.54                | 5.23                | 4.91                | 4.64                | 4.40                | 4.25                | 4.03                | 3.90                | <b>1.5<br/>9</b> | 29.<br>9%             |
| total  | <b>400-760</b> | <b>15.9<br/>984</b>        | <b>15.5<br/>911</b> | <b>16.3<br/>126</b> | <b>16.9<br/>269</b> | <b>17.4<br/>696</b> | <b>17.9<br/>679</b> | <b>18.4<br/>699</b> | <b>18.9<br/>267</b> | <b>19.4<br/>881</b> | <b>19.8<br/>482</b> | <b>20.2<br/>826</b> | <b>5.3<br/>1</b> | 99.<br>8%             |
| %fluorescenc<br>e                                  |                | 47.2<br>%                  | 41.4<br>%           | 36.6<br>%           | 32.7<br>%           | 29.9<br>%           | 27.3<br>%           | 25.1<br>%           | 23.3<br>%           | 21.8<br>%           | 20.3<br>%           | 19.2<br>%           | <b>0.3<br/>0</b> | 29.<br>9%             |
| purple   | (400)-<br>450  | 6.80<br>19                 | 6.96<br>90          | 7.53<br>93          | 7.99<br>27          | 8.34<br>30          | 8.66<br>85          | 8.95<br>54          | 9.21<br>82          | 9.49<br>51          | 9.69<br>72          | 9.88<br>83          | <b>2.5<br/>1</b> | 47.<br>2%             |
| Blue   | <b>450-500</b> | 1.64<br>08                 | 2.15<br>89          | 2.79<br>65          | 3.38<br>03          | 3.88<br>57          | 4.37<br>48          | 4.85<br>27          | 5.28<br>97          | 5.72<br>59          | 6.09<br>89          | 6.46<br>42          | <b>1.2<br/>1</b> | 22.<br>7%             |
| Green  | <b>500-570</b> | 2.00<br>31                 | 1.74<br>98          | 1.65<br>86          | 1.57<br>46          | 1.50<br>63          | 1.43<br>74          | 1.37<br>32          | 1.31<br>44          | 1.27<br>75          | 1.22<br>80          | 1.20<br>09          | <b>0.4<br/>5</b> | 8.5<br>%              |
| Yellow   | <b>570-591</b> | 2.27<br>68                 | 1.90<br>07          | 1.70<br>88          | 1.55<br>59          | 1.44<br>41          | 1.34<br>56          | 1.25<br>76          | 1.18<br>45          | 1.12<br>07          | 1.06<br>06          | 1.01<br>33          | <b>0.4<br/>5</b> | 8.4<br>%              |
| Orange   | <b>591-610</b> | 1.49<br>27                 | 1.25<br>19          | 1.13<br>45          | 1.04<br>06          | 0.97<br>09          | 0.91<br>20          | 0.85<br>36          | 0.80<br>80          | 0.77<br>02          | 0.73<br>36          | 0.70<br>40          | <b>0.3<br/>0</b> | 5.6<br>%              |
| Red  | <b>610-760</b> | 1.83<br>87                 | 1.60<br>80          | 1.51<br>82          | 1.42<br>29          | 1.35<br>68          | 1.26<br>51          | 1.21<br>06          | 1.14<br>33          | 1.12<br>91          | 1.05<br>84          | 1.03<br>97          | <b>0.4<br/>1</b> | 7.6<br>%              |
| total  | (400-<br>700)  | <b>16.0<br/>5</b>          | <b>15.6<br/>4</b>   | <b>16.3<br/>6</b>   | <b>16.9<br/>7</b>   | <b>17.5<br/>1</b>   | <b>18.0<br/>0</b>   | <b>18.5<br/>0</b>   | <b>18.9<br/>6</b>   | <b>19.5<br/>2</b>   | <b>19.8<br/>8</b>   | <b>20.3<br/>1</b>   | <b>5.3<br/>2</b> | 100.<br>.0<br>%       |

Table 16: Fiber 13 - Nylon + Eosin Inside, UP + Lurol Oil Outside (25-30 minutes)

| Fiber 13 - Nylon + Eosin Inside, UP + Lurol Oil Outside (25-30 minutes) |           | mW/cm2 at 5 cm |              |              |              |              |              |              |              |              |             |              |           |          |          |
|---|-----------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|--------------|-----------|----------|----------|
|   |           | 0              | 0,5 min      | 1 min        | 1,5 min      | 2 min        | 2,5 min      | 3 min        | 3,5 min      | 4 min        | 4,5 min     | 5 min        | J/c m2    |          |          |
| Lamp  | 400-518   | 24.9<br>6      | 25.0<br>5    | 25.1<br>9    | 25.2<br>9    | 25.4<br>2    | 25.4<br>9    | 25.6<br>1    | 25.6<br>8    | 25.7<br>8    | 25.9<br>0   | 25.9<br>9    | 7.6<br>3  | 93.0%    | 0.5 7.0% |
| Fluoresc.   | 519-760   | 1.98           | 1.93         | 1.93         | 1.95         | 1.91         | 1.90         | 1.89         | 1.84         | 1.88         | 1.86        | 1.84         | 1.84<br>7 |          |          |
| total   | 400-760   | 26.9<br>3968   | 26.9<br>8401 | 27.1<br>1688 | 27.2<br>4167 | 27.3<br>2461 | 27.3<br>8227 | 27.4<br>9843 | 27.5<br>2573 | 27.6<br>6029 | 27.7<br>626 | 27.8<br>3434 | 8.2<br>0  | 99.9%    |          |
| %fluorescence   |           | 7.4<br>%       | 7.2<br>%     | 7.1<br>%     | 7.2<br>%     | 7.0<br>%     | 6.9<br>%     | 6.9<br>%     | 6.7<br>%     | 6.8<br>%     | 6.7<br>%    | 6.6<br>%     | 0.0<br>7  | 7.0<br>% |          |
| purple  | (400)-450 | 13.4<br>292    | 13.4<br>647  | 13.5<br>354  | 13.5<br>872  | 13.6<br>501  | 13.6<br>725  | 13.7<br>437  | 13.7<br>672  | 13.8<br>125  | 13.8<br>662 | 13.9<br>151  | 4.1<br>0  | 49.9%    |          |
| Blue  | 450-500   | 11.4<br>229    | 11.4<br>809  | 11.5<br>418  | 11.5<br>944  | 11.6<br>551  | 11.7<br>014  | 11.7<br>509  | 11.8<br>032  | 11.8<br>555  | 11.9<br>193 | 11.9<br>667  | 3.5<br>0  | 42.7%    |          |
| Green   | 500-570   | 0.74<br>22     | 0.73<br>41   | 0.73<br>30   | 0.73<br>72   | 0.72<br>89   | 0.72<br>64   | 0.72<br>99   | 0.72<br>29   | 0.73<br>23   | 0.73<br>94  | 0.72<br>30   | 0.2<br>2  | 2.7<br>% |          |
| Yellow  | 570-591   | 0.40<br>73     | 0.39<br>98   | 0.39<br>82   | 0.39<br>78   | 0.39<br>23   | 0.39<br>09   | 0.38<br>53   | 0.38<br>33   | 0.37<br>93   | 0.37<br>86  | 0.37<br>37   | 0.1<br>2  | 1.4<br>% |          |
| Orange  | 591-610   | 0.32<br>98     | 0.32<br>35   | 0.32<br>30   | 0.32<br>12   | 0.31<br>83   | 0.31<br>70   | 0.31<br>28   | 0.31<br>03   | 0.30<br>79   | 0.30<br>66  | 0.30<br>36   | 0.1<br>0  | 1.2<br>% |          |
| Red   | 610-760   | 0.62<br>31     | 0.59<br>54   | 0.59<br>99   | 0.61<br>83   | 0.59<br>43   | 0.58<br>83   | 0.58<br>99   | 0.55<br>28   | 0.58<br>67   | 0.57<br>62  | 0.56<br>59   | 0.1<br>8  | 2.2<br>% |          |
| total   | (400-700) | 26.9<br>5      | 27.0<br>0    | 27.1<br>3    | 27.2<br>6    | 27.3<br>4    | 27.4<br>0    | 27.5<br>1    | 27.5<br>4    | 27.6<br>7    | 27.7<br>8   | 27.8<br>5    | 8.2<br>1  | 10.0%    |          |

Table 17: Fiber 14 - Nylon + Eosin Inside, Bicarbonate + Lurol Oil Outside (25-30 minutes)

| Fiber 14 - Nylon + Eosin Inside, Bicarbonate + Lurol Oil Outside (25-30 minutes) |           | mW/cm2 at 5 cm |              |              |              |              |              |              |              |              |              |             |          |          |  |
|--|-----------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|----------|----------|--|
|  |           | 0              | 0,5 min      | 1 min        | 1,5 min      | 2 min        | 2,5 min      | 3 min        | 3,5 min      | 4 min        | 4,5 min      | 5 min       | J/c m2   |          |  |
| Lamp   | 400-518   | 27.0<br>4      | 27.1<br>0    | 27.2<br>0    | 27.1<br>3    | 27.1<br>2    | 27.2<br>1    | 27.3<br>0    | 27.3<br>7    | 27.4<br>9    | 27.5<br>8    | 27.5<br>3   | 8.1<br>8 | 94.4%    |  |
| Fluoresc.  | 519-760   | 1.72           | 1.70         | 1.69         | 1.65         | 1.61         | 1.59         | 1.59         | 1.57         | 1.54         | 1.56         | 1.49        | 0.4<br>9 | 5.6<br>% |  |
| total  | 400-760   | 28.7<br>625    | 28.8<br>0483 | 28.8<br>8949 | 28.7<br>7401 | 28.7<br>2682 | 28.7<br>9745 | 28.8<br>9051 | 28.9<br>4176 | 29.0<br>2669 | 29.1<br>4196 | 29.0<br>172 | 8.6<br>6 | 10.0%    |  |
| %fluorescence  |           | 6.0<br>%       | 5.9<br>%     | 5.8<br>%     | 5.7<br>%     | 5.6<br>%     | 5.5<br>%     | 5.5<br>%     | 5.4<br>%     | 5.3<br>%     | 5.3<br>%     | 5.1<br>%    | 0.0<br>6 | 5.6<br>% |  |
| purple   | (400)-450 | 14.7<br>774    | 14.7<br>599  | 14.7<br>845  | 14.7<br>271  | 14.6<br>997  | 14.7<br>221  | 14.7<br>524  | 14.7<br>707  | 14.8<br>138  | 14.8<br>509  | 14.7<br>998 | 4.4<br>3 | 51.1%    |  |
| Blue   | 450-500   | 12.1<br>575    | 12.2<br>336  | 12.3<br>042  | 12.2<br>857  | 12.3<br>044  | 12.3<br>716  | 12.4<br>369  | 12.4<br>876  | 12.5<br>577  | 12.6<br>191  | 12.6<br>099 | 3.7<br>1 | 42.8%    |  |
| Green  | 500-570   | 0.78<br>17     | 0.77<br>52   | 0.77<br>11   | 0.75<br>25   | 0.74<br>03   | 0.74<br>25   | 0.74<br>07   | 0.73<br>76   | 0.72<br>91   | 0.72<br>82   | 0.72<br>90  | 0.2<br>2 | 2.6<br>% |  |
| Yellow   | 570-591   | 0.35<br>52     | 0.35<br>22   | 0.34<br>84   | 0.33<br>32   | 0.32<br>94   | 0.32<br>25   | 0.32<br>16   | 0.31<br>95   | 0.31<br>33   | 0.31<br>50   | 0.30<br>54  | 0.1<br>0 | 1.1<br>% |  |
| Orange   | 591-610   | 0.26<br>53     | 0.26<br>23   | 0.25<br>93   | 0.24<br>96   | 0.24<br>76   | 0.23<br>97   | 0.23<br>98   | 0.23<br>85   | 0.23<br>26   | 0.23<br>65   | 0.22<br>63  | 0.0<br>7 | 0.9<br>% |  |

|              |                  |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                        |                                     |
|--------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|-------------------------------------|
| <b>Red</b>   | <b>610-760</b>   | 0.43<br>70              | 0.43<br>30              | 0.43<br>33              | 0.43<br>69              | 0.41<br>62              | 0.40<br>97              | 0.40<br>97              | 0.39<br>82              | 0.39<br>04              | 0.40<br>27              | 0.36<br>66              | <b>0.1</b><br><b>3</b> | 1.4<br>%                            |
| <b>total</b> | <b>(400-700)</b> | <b>28.7</b><br><b>7</b> | <b>28.8</b><br><b>2</b> | <b>28.9</b><br><b>0</b> | <b>28.7</b><br><b>8</b> | <b>28.7</b><br><b>4</b> | <b>28.8</b><br><b>1</b> | <b>28.9</b><br><b>0</b> | <b>28.9</b><br><b>5</b> | <b>29.0</b><br><b>4</b> | <b>29.1</b><br><b>5</b> | <b>29.0</b><br><b>3</b> | <b>8.6</b><br><b>7</b> | <b>10</b><br><b>0.0</b><br><b>%</b> |

Table 18: Fiber 15 - Nylon + Eosin Inside, Eosin + Lurol Oil Outside - Trial 2 (25-30 minutes)

| Fiber 15 - Nylon + Eosin Inside, Eosin + Lurol Oil Outside - Trial 2 (25-30 minutes) |                  | mW/cm <sup>2</sup> at 5 cm |                            |                            |                            |                            |                            |                            |                            |                            |                            |                         |                        |                |
|--|------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------------------------|------------------------|----------------|
|  |                  | 0                          | 0,5 min                    | 1 min                      | 1,5 min                    | 2 min                      | 2,5 min                    | 3 min                      | 3,5 min                    | 4 min                      | 4,5 min                    | 5 min                   | J/cm <sup>2</sup>      |                |
| <b>Lamp</b>  | <b>400-518</b>   | 18.9<br>5                  | 19.0<br>6                  | 19.1<br>9                  | 19.2<br>9                  | 19.4<br>1                  | 19.4<br>9                  | 19.6<br>1                  | 19.7<br>4                  | 19.8<br>3                  | 19.9<br>4                  | 20.<br>05               | <b>5.</b><br><b>84</b> | 89.<br>8%      |
| <b>Fluoresc.</b>   | <b>519-760</b>   | 2.25                       | 2.23                       | 2.24                       | 2.19                       | 2.20                       | 2.17                       | 2.18                       | 2.19                       | 2.15                       | 2.15                       | 2.1                     | <b>0.</b><br><b>66</b> | 10.<br>1%      |
| <b>total</b>   | <b>400-760</b>   | <b>21.2</b><br><b>0136</b> | <b>21.2</b><br><b>8697</b> | <b>21.4</b><br><b>2811</b> | <b>21.4</b><br><b>8191</b> | <b>21.6</b><br><b>0579</b> | <b>21.6</b><br><b>6376</b> | <b>21.7</b><br><b>8431</b> | <b>21.9</b><br><b>2765</b> | <b>21.9</b><br><b>8483</b> | <b>22.0</b><br><b>8331</b> | <b>22.</b><br><b>04</b> | <b>6.</b><br><b>49</b> | 99.<br>9%      |
| <b>%fluorescence</b>   |                  | 10.6<br>%                  | 10.5<br>%                  | 10.4<br>%                  | 10.2<br>%                  | 10.2<br>%                  | 10.0<br>%                  | 10.0<br>%                  | 10.0<br>%                  | 9.8<br>%                   | 9.7<br>%                   | 9.6<br>%                | <b>0.</b><br><b>10</b> | 10.<br>1%      |
| <b>purple</b>  | <b>(400)-450</b> | 10.4<br>090                | 10.4<br>463                | 10.5<br>206                | 10.5<br>657                | 10.6<br>302                | 10.6<br>576                | 10.7<br>182                | 10.7<br>853                | 10.8<br>302                | 10.8<br>776                | 10.<br>929              | <b>3.</b><br><b>19</b> | 49.<br>1%      |
| <b>Blue</b>  | <b>450-500</b>   | 8.49<br>99                 | 8.56<br>73                 | 8.62<br>48                 | 8.67<br>59                 | 8.73<br>48                 | 8.78<br>71                 | 8.84<br>30                 | 8.90<br>77                 | 8.95<br>36                 | 9.00<br>93                 | 9.0<br>661              | <b>2.</b><br><b>63</b> | 40.<br>4%      |
| <b>Green</b>   | <b>500-570</b>   | 0.51<br>79                 | 0.51<br>98                 | 0.52<br>27                 | 0.51<br>33                 | 0.51<br>39                 | 0.51<br>28                 | 0.51<br>24                 | 0.52<br>41                 | 0.51<br>77                 | 0.51<br>55                 | 0.5<br>159              | <b>0.</b><br><b>16</b> | 2.4<br>%       |
| <b>Yellow</b>  | <b>570-591</b>   | 0.51<br>74                 | 0.51<br>38                 | 0.50<br>96                 | 0.50<br>43                 | 0.50<br>29                 | 0.49<br>97                 | 0.49<br>90                 | 0.49<br>89                 | 0.49<br>41                 | 0.48<br>92                 | 0.4<br>894              | <b>0.</b><br><b>15</b> | 2.3<br>%       |
| <b>Orange</b>  | <b>591-610</b>   | 0.45<br>25                 | 0.44<br>74                 | 0.44<br>39                 | 0.43<br>96                 | 0.43<br>84                 | 0.43<br>49                 | 0.43<br>42                 | 0.43<br>22                 | 0.42<br>82                 | 0.42<br>64                 | 0.4<br>245              | <b>0.</b><br><b>13</b> | 2.0<br>%       |
| <b>Red</b>   | <b>610-760</b>   | 0.82<br>50                 | 0.81<br>23                 | 0.82<br>63                 | 0.80<br>28                 | 0.80<br>53                 | 0.79<br>11                 | 0.79<br>70                 | 0.79<br>88                 | 0.78<br>03                 | 0.78<br>46                 | 0.7<br>707              | <b>0.</b><br><b>24</b> | 3.7<br>%       |
| <b>total</b>   | <b>(400-700)</b> | <b>21.2</b><br><b>2</b>    | <b>21.3</b><br><b>1</b>    | <b>21.4</b><br><b>5</b>    | <b>21.5</b><br><b>0</b>    | <b>21.6</b><br><b>3</b>    | <b>21.6</b><br><b>8</b>    | <b>21.8</b><br><b>0</b>    | <b>21.9</b><br><b>5</b>    | <b>22.0</b><br><b>0</b>    | <b>22.1</b><br><b>0</b>    | <b>22.</b><br><b>20</b> | <b>6.</b><br><b>50</b> | 10<br>0.0<br>% |

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Table 19: Photoactivatable fibers comprising polybutylene terephthalate (PBT) compounded with Eosin

| <b>Fiber</b> | <b>Composition</b>   | <b>Fluorescence Emission</b> |
|--------------|--|------------------------------|
| 16           | Virgin PBT + Lurol Oil Coating                                     | Table 20                     |
| 17           | PBT with 1% Eosin + Lurol Oil Coating                              | Table 21                     |
| 18           | PBT with 1% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating   | Table 22                     |
| 19           | PBT with 1% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 23                     |
| 20           | PBT with 1% Eosin + 10 g/L Eosin Y Coating + Lurol Oil Coating     | Table 24                     |

Table 20: Fiber 16 - PBT Blank

| Fiber 16 - PBT Blank |           | mW/cm <sup>2</sup> at 5 cm |         |          |           |          |          |          |          |          |         |          |        |        |
|----------------------|-----------|----------------------------|---------|----------|-----------|----------|----------|----------|----------|----------|---------|----------|--------|--------|
|                      |           | 0                          | 0,5 min | 1 min    | 1,5 min   | 2 min    | 2,5 min  | 3 min    | 3,5 min  | 4 min    | 4,5 min | 5 min    |        |        |
| Lamp                 | 400-518   | 69.35                      | 69.24   | 68.903   | 68.53     | 68.16    | 68.04    | 67.72    | 67.51    | 67.29    | 67.15   | 20.54    | 99.9%  |        |
| Fluoresc.            | 519-760   | 0.05                       | 0.07    | 0.06     | 0.05      | 0.05     | 0.06     | 0.05     | 0.07     | 0.06     | 0.05    | 0.04     | 0.02%  |        |
| total                | 400-760   | 69.82895                   | 69.4195 | 69.30044 | 68.95217  | 68.5783  | 68.21259 | 68.09006 | 67.79068 | 67.56456 | 67.3467 | 67.19618 | 20.55  | 100.0% |
| %fluorescence        |           | 0.1%                       | 0.1%    | 0.1%     | 0.1%      | 0.1%     | 0.1%     | 0.1%     | 0.1%     | 0.1%     | 0.1%    | 0.1%     | 0.00%  |        |
| purple               | (400)-450 | 42.9096                    | 42.0190 | 41.5394  | 40.9650   | 40.4537  | 39.9428  | 39.6390  | 39.2507  | 38.9616  | 38.6804 | 38.4675  | 12.13  | 59.0%  |
| Blue                 | 450-500   | 26.7852                    | 27.2232 | 27.5890  | 27.8149   | 27.9591  | 28.0905  | 28.2822  | 28.3575  | 28.4216  | 28.4878 | 28.5608  | 8.37   | 40.7%  |
| Green                | 500-570   | 0.1043                     | 0.1571  | 0.1564   | 0.1587    | 0.1566   | 0.1574   | 0.1648   | 0.1639   | 0.1680   | 0.1621  | 0.1529   | 0.05   | 0.2%   |
| Yellow               | 570-591   | 0.0000                     | 0.0052  | 0.0084   | 0.0098    | 0.00050  | 0.0067   | 0.0040   | 0.0110   | 0.0079   | 0.0106  | 0.0061   | 0.00   | 0.0%   |
| Orange               | 591-610   | 0.0000                     | 0.0088  | 0.0059   | 0.0033    | 0.000735 | 0.0087   | 0.00011  | 0.0069   | 0.0049   | 0.00558 | 0.0000   | 0.00   | 0.0%   |
| Red                  | 610-760   | 0.0299                     | 0.0066  | 0.0016   | 0.0006    | 0.0001   | 0.0071   | 0.0000   | 0.0010   | 0.0006   | 0.0001  | 0.0020   | 0.00   | 0.0%   |
| total                | (400-700) | 69.469.832                 | 69.30   | 68.958   | 68.568.21 | 68.09    | 67.79    | 67.565   | 67.35    | 67.20    | 67.19   | 20.55    | 100.0% |        |

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Table 21: Fiber 17 - PBT + Eosin Inside, Lurol Oil Outside

| Fiber 17 - PBT + Eosin Inside, Lurol Oil Outside |           | mW/cm <sup>2</sup> at 5 cm |         |        |         |        |         |        |         |        |         |        |      |        |
|--|-----------|----------------------------|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|------|--------|
|  |           | 0                          | 0,5 min | 1 min  | 1,5 min | 2 min  | 2,5 min | 3 min  | 3,5 min | 4 min  | 4,5 min | 5 min  |      |        |
| Lamp   | 400-518   | 2.63                       | 2.57    | 2.41   | 2.18    | 2.06   | 1.99    | 2.26   | 2.34    | 2.30   | 2.28    | 2.24   | 0.69 | 47.1%  |
| Fluoresc.  | 519-760   | 2.83                       | 2.73    | 2.71   | 2.64    | 2.58   | 2.51    | 2.45   | 2.40    | 2.36   | 2.34    | 2.33   | 0.77 | 52.3%  |
| total  | 400-760   | 5.468                      | 5.297   | 5.122  | 4.827   | 4.643  | 4.503   | 4.706  | 4.732   | 4.659  | 4.618   | 4.579  | 1.46 | 99.4%  |
| %fluorescence                                    |           | 51.8%                      | 51.5%   | 53.0%  | 54.8%   | 55.6%  | 55.8%   | 52.1%  | 50.6%   | 50.7%  | 50.7%   | 50.9%  | 0.53 | 52.6%  |
| purple   | (400)-450 | 1.8166                     | 1.7553  | 1.6450 | 1.5014  | 1.4223 | 1.3755  | 1.5282 | 1.5655  | 1.5335 | 1.5147  | 1.4931 | 0.47 | 32.0%  |
| Blue   | 450-500   | 0.8139                     | 0.8126  | 0.7602 | 0.6817  | 0.6405 | 0.6139  | 0.7270 | 0.7718  | 0.7606 | 0.7591  | 0.7499 | 0.22 | 15.0%  |
| Green  | 500-570   | 0.0536                     | 0.0543  | 0.0575 | 0.0548  | 0.0545 | 0.0552  | 0.0543 | 0.0554  | 0.0537 | 0.0556  | 0.0561 | 0.02 | 1.1%   |
| Yellow   | 570-591   | 0.5284                     | 0.4851  | 0.4763 | 0.4619  | 0.4510 | 0.4395  | 0.4304 | 0.4193  | 0.4146 | 0.4093  | 0.4090 | 0.14 | 9.2%   |
| Orange   | 591-610   | 0.7208                     | 0.6774  | 0.6674 | 0.6502  | 0.6344 | 0.6149  | 0.5997 | 0.5842  | 0.5764 | 0.5684  | 0.5648 | 0.19 | 12.9%  |
| Red  | 610-760   | 1.5646                     | 1.5467  | 1.5464 | 1.5100  | 1.4731 | 1.4350  | 1.3972 | 1.3685  | 1.3481 | 1.3375  | 1.3262 | 0.44 | 29.7%  |
| total  | (400-700) | 5.50                       | 5.33    | 5.15   | 4.86    | 4.68   | 4.53    | 4.74   | 4.76    | 4.69   | 4.64    | 4.60   | 1.47 | 100.0% |

Table 22: Fiber 18 - PBT + Eosin Inside, UP + Lurol Oil Outside

| Fiber 18 - PBT + Eosin Inside, UP + Lurol Oil Outside |                | mW/cm2 at 5 cm   |                  |                  |                  |                  |                  |                  |                 |                  |                  |               |              |              |       |
|---|----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-----------------|------------------|------------------|---------------|--------------|--------------|-------|
|   |                | 0                | 0,5 min          | 1 min            | 1,5 min          | 2 min            | 2,5 min          | 3 min            | 3,5 min         | 4 min            | 4,5 min          | 5 min         | J/c m 2      |              |       |
| Lamp  | <b>400-518</b> | 0.42             | 0.46             | 1.12             | 0.91             | 0.91             | 0.96             | 0.99             | 0.99            | 0.99             | 1.08             | 1.07          | <b>0.2 6</b> | 32.0%        |       |
| Fluoresc.   | <b>519-760</b> | 2.32             | 2.04             | 1.90             | 1.84             | 1.81             | 1.78             | 1.76             | 1.72            | 1.69             | 1.66             | 1.63          | <b>0.5 6</b> | 67.2%        |       |
| total   | <b>400-760</b> | <b>2.74 0057</b> | <b>2.49 5696</b> | <b>3.02 1197</b> | <b>2.74 4473</b> | <b>2.72 7173</b> | <b>2.74 0978</b> | <b>2.74 4468</b> | <b>2.71 341</b> | <b>2.67 8671</b> | <b>2.743 669</b> | <b>2.69 5</b> | <b>649 2</b> | 99.3%        |       |
| %fluorescence   |                | 84.6%            | 81.8%            | 63.0%            | 66.9%            | 66.5%            | 65.1%            | 64.0%            | 63.4%           | 63.1%            | 60.6%            | 60.3%         | <b>0.6 8</b> | 67.7%        |       |
| purple  | (400)-450      | 0.30<br>91       | 0.31<br>71       | 0.70<br>94       | 0.58<br>82       | 0.59<br>08       | 0.61<br>57       | 0.63<br>25       | 0.63<br>33      | 0.63<br>06       | 0.680<br>7       | 0.67<br>34    | <b>0.1 7</b> | 20.7%        |       |
| Blue  | <b>450-500</b> | 0.11<br>26       | 0.13<br>79       | 0.40<br>59       | 0.31<br>84       | 0.32<br>10       | 0.33<br>96       | 0.35<br>49       | 0.35<br>80      | 0.35<br>72       | 0.399<br>0       | 0.39<br>55    | <b>0.0 9</b> | 11.3%        |       |
| Green   | <b>500-570</b> | 0.04<br>97       | 0.04<br>12       | 0.04<br>47       | 0.04<br>30       | 0.04<br>41       | 0.04<br>44       | 0.04<br>52       | 0.04<br>63      | 0.04<br>03       | 0.04<br>53       | 0.047<br>1    | 0.04<br>70   | <b>0.0 1</b> | 1.6%  |
| Yellow  | <b>570-591</b> | 0.43<br>15       | 0.36<br>09       | 0.34<br>14       | 0.32<br>98       | 0.32<br>47       | 0.32<br>02       | 0.31<br>63       | 0.31<br>03      | 0.31<br>53       | 0.30<br>9        | 0.300<br>59   | 0.29<br>0    | <b>0.1 0</b> | 12.1% |
| Orange  | <b>591-610</b> | 0.54<br>79       | 0.47<br>94       | 0.44<br>56       | 0.42<br>91       | 0.42<br>12       | 0.41<br>30       | 0.40<br>54       | 0.39<br>58      | 0.38<br>73       | 0.380<br>0       | 0.37<br>15    | <b>0.1 3</b> | 15.6%        |       |
| Red   | <b>610-760</b> | 1.31<br>54       | 1.18<br>22       | 1.09<br>55       | 1.05<br>64       | 1.04<br>56       | 1.02<br>77       | 1.00<br>96       | 0.98<br>93      | 0.97<br>04       | 0.953<br>9       | 0.93<br>09    | <b>0.3 2</b> | 38.6%        |       |
| total   | (400-700)      | <b>2.77</b>      | <b>2.52</b>      | <b>3.04</b>      | <b>2.76</b>      | <b>2.75</b>      | <b>2.76</b>      | <b>2.76</b>      | <b>2.73</b>     | <b>2.70</b>      | <b>2.76</b>      | <b>2.71</b>   | <b>0.8 3</b> | 100.0%       |       |

Table 23: Fiber 19 - PBT + Eosin Inside, Bicarb + Lurol Oil Outside

| Fiber 19 - PBT + Eosin Inside, Bicarb + Lurol Oil Outside |                | mW/cm2 at 5 cm    |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |              |       |
|---|----------------|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------|-------|
|   |                | 0                 | 0,5 min         | 1 min           | 1,5 min         | 2 min           | 2,5 min         | 3 min           | 3,5 min         | 4 min           | 4,5 min         | 5 min           | J/c m 2      |       |
| Lamp  | <b>400-518</b> | 0.55              | 0.56            | 1.00            | 1.17            | 1.25            | 1.08            | 1.05            | 1.05            | 1.09            | 1.11            | 1.13            | <b>0.3 0</b> | 34.4% |
| Fluoresc.   | <b>519-760</b> | 2.40              | 2.11            | 1.94            | 1.86            | 1.78            | 1.76            | 1.74            | 1.71            | 1.69            | 1.66            | 1.64            | <b>0.5 6</b> | 64.9% |
| total   | <b>400-760</b> | <b>2.95 2.414</b> | <b>2.66 700</b> | <b>2.94 272</b> | <b>3.02 863</b> | <b>3.03 526</b> | <b>2.84 118</b> | <b>2.78 710</b> | <b>2.76 632</b> | <b>2.77 791</b> | <b>2.77 009</b> | <b>2.77 482</b> | <b>0.8 6</b> | 99.3% |
| %fluorescence   |                | 81.4%             | 79.1%           | 65.9%           | 61.5%           | 58.7%           | 62.1%           | 62.4%           | 61.9%           | 60.9%           | 60.1%           | 59.2%           | <b>0.6 5</b> | 65.3% |
| purple  | (400)-450      | 0.39<br>23        | 0.38<br>86      | 0.65<br>57      | 0.75<br>12      | 0.79<br>70      | 0.69<br>04      | 0.66<br>87      | 0.67<br>07      | 0.68<br>70      | 0.69<br>62      | 0.70<br>91      | <b>0.1 9</b> | 22.2% |
| Blue  | <b>450-500</b> | 0.15<br>66        | 0.16<br>76      | 0.34<br>67      | 0.41<br>36      | 0.45<br>62      | 0.38<br>52      | 0.37<br>75      | 0.38<br>28      | 0.39<br>89      | 0.39<br>86      | 0.40<br>25      | <b>0.1 0</b> | 12.1% |
| Green   | <b>500-570</b> | 0.05<br>04        | 0.04<br>08      | 0.04<br>09      | 0.04<br>16      | 0.04<br>04      | 0.04<br>25      | 0.04<br>32      | 0.04<br>41      | 0.04<br>49      | 0.04<br>53      | 0.04<br>60      | <b>0.0 1</b> | 1.5%  |
| Yellow  | <b>570-591</b> | 0.44<br>00        | 0.36<br>07      | 0.33<br>12      | 0.31<br>99      | 0.30<br>66      | 0.30<br>23      | 0.29<br>83      | 0.29<br>35      | 0.29<br>04      | 0.28<br>69      | 0.28<br>34      | <b>0.1 0</b> | 11.2% |
| Orange  | <b>591-610</b> | 0.56<br>68        | 0.49<br>37      | 0.45<br>19      | 0.43<br>18      | 0.41<br>19      | 0.40<br>49      | 0.39<br>78      | 0.38<br>95      | 0.38<br>35      | 0.37<br>68      | 0.37<br>05      | <b>0.1 3</b> | 15.0% |

|       |           |            |            |            |            |            |            |            |            |            |            |            |          |                |
|-------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------|----------------|
| Red   | 610-760   | 1.37<br>50 | 1.23<br>94 | 1.13<br>82 | 1.09<br>13 | 1.04<br>31 | 1.03<br>53 | 1.02<br>07 | 1.00<br>44 | 0.99<br>17 | 0.97<br>44 | 0.96<br>12 | 0.3<br>3 | 37.<br>9%      |
| total | (400-700) | 2.98       | 2.69       | 2.96       | 3.05       | 3.06       | 2.86       | 2.81       | 2.79       | 2.80       | 2.79       | 2.79       | 0.8<br>6 | 100<br>.0<br>% |

Table 24: Fiber 20 - PBT + Eosin Inside, Eosin + Lurol Oil Outside

| Fiber 20 - PBT + Eosin Inside, Eosin + Lurol Oil Outside |           | mW/cm <sup>2</sup> at 5 cm |              |              |              |              |              |              |              |             |              |            | J/c m <sup>2</sup> |                |
|--|-----------|----------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|--------------|------------|--------------------|----------------|
|  |           | 0                          | 0,5 min      | 1 min        | 1,5 min      | 2 min        | 2,5 min      | 3 min        | 3,5 min      | 4 min       | 4,5 min      | 5 min      |                    |                |
| Lamp   | 400-518   | 3.25                       | 3.82         | 3.91         | 4.14         | 4.19         | 4.39         | 4.35         | 4.30         | 4.27        | 4.27         | 4.24       | 1.2<br>3           | 62.<br>9%      |
| Fluoresc.  | 519-760   | 2.72                       | 2.62         | 2.54         | 2.42         | 2.36         | 2.30         | 2.27         | 2.23         | 2.20        | 2.17         | 2.16       | 0.7<br>2           | 36.<br>7%      |
| total  | 400-760   | 5.96<br>6188               | 6.44<br>1835 | 6.45<br>0766 | 6.55<br>7832 | 6.54<br>9098 | 6.69<br>4657 | 6.62<br>2601 | 6.52<br>0864 | 6.46<br>933 | 6.436<br>219 | 432<br>5   | 1.9<br>4           | 99.<br>6%      |
| %fluorescence  |           | 45.6<br>%                  | 40.7<br>%    | 39.4<br>%    | 36.9<br>%    | 36.0<br>%    | 34.4<br>%    | 34.3<br>%    | 34.1<br>%    | 34.1<br>%   | 33.7<br>%    | 33.8<br>%  | 0.3<br>7           | 36.<br>8%      |
| purple   | (400)-450 | 2.18<br>23                 | 2.50<br>14   | 2.53<br>69   | 2.65<br>63   | 2.66<br>42   | 2.77<br>16   | 2.73<br>08   | 2.68<br>52   | 2.65<br>68  | 2.646<br>9   | 2.62<br>11 | 0.7<br>8           | 40.<br>1%      |
| Blue   | 450-500   | 1.06<br>44                 | 1.31<br>31   | 1.37<br>03   | 1.47<br>81   | 1.52<br>45   | 1.61<br>90   | 1.61<br>81   | 1.60<br>76   | 1.60<br>56  | 1.615<br>5   | 1.61<br>14 | 0.4<br>4           | 22.<br>8%      |
| Green  | 500-570   | 0.05<br>08                 | 0.05<br>54   | 0.05<br>85   | 0.05<br>51   | 0.05<br>56   | 0.05<br>68   | 0.05<br>60   | 0.05<br>46   | 0.05<br>76  | 0.056<br>9   | 0.05<br>67 | 0.0<br>2           | 0.9<br>%       |
| Yellow   | 570-591   | 0.48<br>00                 | 0.43<br>40   | 0.42<br>02   | 0.40<br>71   | 0.39<br>51   | 0.38<br>60   | 0.37<br>97   | 0.37<br>38   | 0.36<br>82  | 0.364<br>4   | 0.36<br>31 | 0.1<br>2           | 6.2<br>%       |
| Orange   | 591-610   | 0.69<br>16                 | 0.64<br>22   | 0.61<br>86   | 0.59<br>36   | 0.57<br>43   | 0.55<br>86   | 0.54<br>88   | 0.53<br>87   | 0.53<br>00  | 0.522<br>9   | 0.51<br>76 | 0.1<br>7           | 9.0<br>%       |
| Red  | 610-760   | 1.53<br>14                 | 1.52<br>75   | 1.47<br>69   | 1.39<br>71   | 1.36<br>37   | 1.33<br>04   | 1.31<br>63   | 1.28<br>75   | 1.27<br>73  | 1.255<br>4   | 1.24<br>99 | 0.4<br>1           | 21.<br>2%      |
| total  | (400-700) | 6.00                       | 6.47         | 6.48         | 6.59         | 6.58         | 6.72         | 6.65         | 6.55         | 6.50        | 6.46         | 6.42       | 1.9<br>5           | 100<br>.0<br>% |

5 Table 25: Photoactivatable fibers comprising poly(methyl methacrylate) (PMMA) compounded with Eosin

| Fiber | Composition  | Fluorescence Emission |
|-------|--|-----------------------|
| 21    | PMMA with 1% Eosin + Lurol Oil Coating                               | Table 26              |
| 22    | PMMA with 1% Eosin + 1% Urea Peroxide Coating + Lurol Oil Coating    | Table 27              |
| 23    | PrMMA with 1% Eosin + Sodium Bicarbonate Coating + Lurol Oil Coating | Table 28              |
| 24    | PMMA with 1% Eosin + 10 g/L Eosin Y Coating + Lurol Oil Coating      | Table 29              |

Table 26: Fiber 21 - PMMA + Eosin Inside, Lurol Oil Outside

| Fiber 21 - PMMA + Eosin Inside, Lurol Oil Outside |           | mW/cm2 at 5 cm   |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  | J/c m2   |           |
|---|-----------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------|-----------|
|   |           | 0                | 0,5 min          | 1 min            | 1,5 min          | 2 min            | 2,5 min          | 3 min            | 3,5 min          | 4 min            | 4,5 min          | 5 min            |          |           |
| Lamp  | 400-518   | 10.2<br>6        | 10.1<br>2        | 10.0<br>8        | 10.0<br>2        | 9.98             | 9.96             | 9.88             | 9.90             | 9.83             | 9.79             | 9.82             | 2.9<br>9 | 93.<br>9% |
| Fluoresc.   | 519-760   | 0.73             | 0.67             | 0.65             | 0.64             | 0.63             | 0.63             | 0.61             | 0.60             | 0.60             | 0.60             | 0.59             | 0.1<br>9 | 6.0<br>%  |
| total   | 400-760   | 10.9<br>937<br>7 | 10.7<br>933<br>5 | 10.7<br>289<br>3 | 10.6<br>581<br>9 | 10.6<br>123<br>1 | 10.5<br>860<br>7 | 10.4<br>954<br>2 | 10.5<br>029<br>6 | 10.4<br>334<br>8 | 10.3<br>916<br>6 | 10.4<br>160<br>2 | 3.1<br>9 | 99.<br>9% |
| %fluorescence                                     |           | 6.7<br>%         | 6.2<br>%         | 6.0<br>%         | 6.0<br>%         | 5.9<br>%         | 5.9<br>%         | 5.9<br>%         | 5.7<br>%         | 5.8<br>%         | 5.8<br>%         | 5.7<br>%         | 0.0<br>6 | 6.0<br>%  |
| purple  | (400)-450 | 7.86<br>15       | 7.63<br>70       | 7.55<br>61       | 7.45<br>10       | 7.36<br>97       | 7.30<br>17       | 7.20<br>94       | 7.18<br>32       | 7.11<br>10       | 7.04<br>89       | 7.04<br>20       | 2.2<br>1 | 69.<br>4% |
| Blue  | 450-500   | 2.39<br>95       | 2.48<br>56       | 2.52<br>76       | 2.56<br>94       | 2.61<br>18       | 2.65<br>71       | 2.67<br>20       | 2.71<br>61       | 2.72<br>00       | 2.74<br>22       | 2.78<br>21       | 0.7<br>8 | 24.<br>6% |
| Green   | 500-570   | 0.00<br>96       | 0.00<br>69       | 0.00<br>50       | 0.00<br>43       | 0.00<br>38       | 0.00<br>33       | 0.00<br>28       | 0.00<br>26       | 0.00<br>25       | 0.00<br>23       | 0.00<br>20       | 0.0<br>0 | 0.0<br>%  |
| Yellow  | 570-591   | 0.13<br>04       | 0.11<br>95       | 0.11<br>28       | 0.10<br>92       | 0.10<br>63       | 0.10<br>37       | 0.10<br>03       | 0.09<br>78       | 0.09<br>63       | 0.09<br>53       | 0.09<br>28       | 0.0<br>3 | 1.0<br>%  |
| Orange  | 591-610   | 0.23<br>26       | 0.21<br>75       | 0.21<br>05       | 0.20<br>74       | 0.20<br>43       | 0.20<br>22       | 0.19<br>77       | 0.19<br>49       | 0.19<br>34       | 0.19<br>22       | 0.18<br>89       | 0.0<br>6 | 1.9<br>%  |
| Red   | 610-760   | 0.37<br>32       | 0.33<br>88       | 0.32<br>84       | 0.32<br>83       | 0.32<br>77       | 0.32<br>93       | 0.32<br>41       | 0.31<br>93       | 0.32<br>11       | 0.32<br>15       | 0.31<br>90       | 0.1<br>0 | 3.1<br>%  |
| total   | (400-700) | 11.0<br>1        | 10.8<br>1        | 10.7<br>4        | 10.6<br>7        | 10.6<br>2        | 10.6<br>0        | 10.5<br>1        | 10.5<br>1        | 10.4<br>4        | 10.4<br>0        | 10.4<br>3        | 3.1<br>9 | 100<br>%  |

Table 27: Fiber 22 - PMMA + Eosin Inside, UP + Lurol Oil Outside

| Fiber 22 - PMMA + Eosin Inside, UP + Lurol Oil Outside |           | mW/cm2 at 5 cm |             |             |             |             |             |             |             |             |             |             | J/c m2   |           |
|--|-----------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|----------|-----------|
|  |           | 0              | 0,5 min     | 1 min       | 1,5 min     | 2 min       | 2,5 min     | 3 min       | 3,5 min     | 4 min       | 4,5 min     | 5 min       |          |           |
| Lamp   | 400-518   | 15.<br>69      | 14.9<br>5   | 14.7<br>4   | 14.5<br>9   | 14.4<br>7   | 14.4<br>2   | 14.3<br>9   | 14.3<br>6   | 14.3<br>3   | 14.2<br>8   | 14.2<br>7   | 4.3<br>9 | 95.<br>7% |
| Fluoresc.  | 519-760   | 0.7<br>5       | 0.67        | 0.66        | 0.64        | 0.64        | 0.63        | 0.63        | 0.63        | 0.62        | 0.61        | 0.60        | 0.1<br>9 | 4.2<br>%  |
| total  | 400-760   | 16.<br>438     | 15.6<br>228 | 15.3<br>958 | 15.2<br>308 | 15.1<br>106 | 15.0<br>507 | 15.0<br>180 | 14.9<br>848 | 14.9<br>507 | 14.8<br>923 | 14.8<br>771 | 4.5<br>1 | 99.<br>9% |
| %fluorescence  |           | 4.6<br>%       | 4.3<br>%    | 4.3<br>%    | 4.2<br>%    | 4.3<br>%    | 4.2<br>%    | 4.2<br>%    | 4.2<br>%    | 4.1<br>%    | 4.1<br>%    | 4.1<br>%    | 0.0<br>4 | 4.2<br>%  |
| purple   | (400)-450 | 11.<br>008     | 10.3<br>2   | 10.1<br>866 | 9.96<br>416 | 9.80<br>91  | 9.71<br>76  | 9.63<br>33  | 9.56<br>69  | 9.50<br>02  | 9.42<br>19  | 9.38<br>61  | 2.9<br>7 | 64.<br>9% |
| Blue   | 450-500   | 4.6<br>795     | 4.56<br>40  | 4.59<br>64  | 4.62<br>07  | 4.65<br>97  | 4.70<br>54  | 4.74<br>96  | 4.79<br>90  | 4.83<br>27  | 4.85<br>59  | 4.89<br>20  | 1.4<br>1 | 30.<br>8% |
| Green  | 500-570   | 0.0<br>004     | 0.00<br>04  | 0.00<br>02  | 0.00<br>00  | 0.0<br>0 | 0.0<br>%  |
| Yellow   | 570-591   | 0.0<br>950     | 0.08<br>42  | 0.08<br>18  | 0.07<br>63  | 0.07<br>59  | 0.07<br>27  | 0.07<br>20  | 0.07<br>03  | 0.07<br>83  | 0.06<br>64  | 0.06<br>42  | 0.0<br>2 | 0.5<br>%  |
| Orange   | 591-610   | 0.2<br>189     | 0.20<br>31  | 0.19<br>87  | 0.19<br>47  | 0.19<br>33  | 0.19<br>01  | 0.18<br>84  | 0.18<br>65  | 0.18<br>28  | 0.18<br>05  | 0.17<br>89  | 0.0<br>6 | 1.3<br>%  |
| Red  | 610-760   | 0.4<br>494     | 0.39<br>65  | 0.38<br>88  | 0.38<br>15  | 0.38<br>56  | 0.38<br>05  | 0.38<br>25  | 0.37<br>99  | 0.37<br>60  | 0.37<br>43  | 0.37<br>21  | 0.1<br>2 | 2.5<br>%  |

|              |                  | 16.<br>45 | 15.6<br>3 | 15.4<br>1 | 15.2<br>4 | 15.1<br>2 | 15.0<br>6 | 15.0<br>3 | 15.0<br>0 | 14.9<br>6 | 14.9<br>0 | 14.8<br>9 | 4.5<br>8 | 100<br>.0<br>% |
|--------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------------|
| <b>total</b> | <b>(400-700)</b> |           |           |           |           |           |           |           |           |           |           |           |          |                |

Table 28: Fiber 23 - PMMA + Eosin Inside, Bicarbonate + Lurol Oil Outside

| Fiber 23 - PMMA + Eosin Inside, Bicarbonate + Lurol Oil Outside |                  | mW/cm2 at 5 cm |             |             |             |             |             |             |             |             |             |             |                   |                |  |
|---|------------------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------------|----------------|--|
|   |                  | 0              | 0,5<br>min  | 1<br>min    | 1,5<br>min  | 2<br>min    | 2,5<br>min  | 3<br>min    | 3,5<br>min  | 4<br>min    | 4,5<br>min  | 5<br>min    | J/<br>c<br>m<br>2 |                |  |
| <b>Lamp</b>   | <b>400-518</b>   | 13.1<br>5      | 13.3        | 13.2        | 13.2        | 13.1<br>3   | 12.8<br>9   | 12.8<br>0   | 12.6<br>9   | 12.5<br>9   | 12.5<br>1   | 3.<br>92    | 95.<br>4%         |                |  |
| <b>Fluoresc.</b>  | <b>519-760</b>   | 0.68           | 0.64        | 0.63        | 0.62        | 0.61        | 0.61        | 0.61        | 0.60        | 0.60        | 0.59        | 0.59        | 0.<br>19          | 4.5<br>%       |  |
| <b>total</b>  | <b>400-760</b>   | 13.8<br>3246   | 14.14<br>25 | 13.9<br>710 | 13.8<br>874 | 13.8<br>263 | 13.7<br>376 | 13.4<br>979 | 13.4<br>027 | 13.2<br>848 | 13.1<br>837 | 13.0<br>999 | 4.<br>10          | 99.<br>9%      |  |
| <b>%fluorescence</b>  |                  | 4.9<br>%       | 4.5<br>4.5% | 4.5<br>%    | 4.5<br>%    | 4.4<br>%    | 4.4<br>%    | 4.5<br>%    | 4.5<br>%    | 4.5<br>%    | 4.5<br>%    | 4.5<br>%    | 0.<br>05          | 4.5<br>%       |  |
| <b>purple</b>   | <b>(400)-450</b> | 9.34<br>41     | 9.413<br>0  | 9.22<br>56  | 9.10<br>99  | 9.01<br>73  | 8.90<br>34  | 8.71<br>26  | 8.61<br>68  | 8.50<br>63  | 8.41<br>82  | 8.34<br>22  | 2.<br>68          | 65.<br>2%      |  |
| <b>Blue</b>   | <b>450-500</b>   | 3.81<br>00     | 4.087<br>7  | 4.11<br>81  | 4.15<br>41  | 4.19<br>99  | 4.22<br>60  | 4.17<br>47  | 4.18<br>28  | 4.17<br>92  | 4.17<br>48  | 4.17<br>04  | 1.<br>24          | 30.<br>2%      |  |
| <b>Green</b>  | <b>500-570</b>   | 0.00<br>00     | 0.000<br>0  | 0.00<br>00  | 0.<br>00          | 0.0<br>%       |  |
| <b>Yellow</b>   | <b>570-591</b>   | 0.08<br>04     | 0.069<br>5  | 0.06<br>64  | 0.06<br>46  | 0.06<br>23  | 0.06<br>06  | 0.06<br>04  | 0.05<br>97  | 0.05<br>91  | 0.05<br>76  | 0.05<br>65  | 0.<br>02          | 0.5<br>%       |  |
| <b>Orange</b>   | <b>591-610</b>   | 0.20<br>44     | 0.188<br>8  | 0.18<br>39  | 0.18<br>19  | 0.17<br>82  | 0.17<br>59  | 0.17<br>61  | 0.17<br>42  | 0.17<br>28  | 0.17<br>04  | 0.16<br>83  | 0.<br>05          | 1.3<br>%       |  |
| <b>Red</b>  | <b>610-760</b>   | 0.40<br>57     | 0.394<br>8  | 0.38<br>81  | 0.38<br>80  | 0.37<br>95  | 0.38<br>24  | 0.38<br>47  | 0.37<br>98  | 0.37<br>80  | 0.37<br>32  | 0.37<br>29  | 0.<br>12          | 2.8<br>%       |  |
| <b>total</b>  | <b>(400-700)</b> | 13.8<br>4      | 14.15<br>8  | 13.9<br>0   | 13.9<br>4   | 13.8<br>5   | 13.7<br>1   | 13.5<br>1   | 13.4<br>0   | 13.3<br>9   | 13.1<br>1   | 13.1<br>1   | 4.<br>11          | 100<br>.0<br>% |  |

5

Table 29: Fiber 24 - PMMA + Eosin Inside, Eosin + Lurol Oil Outside

| Fiber 24 - PMMA + Eosin Inside, Eosin + Lurol Oil Outside |                  | mW/cm2 at 5 cm |             |             |             |             |             |             |             |             |             |             |               |           |  |
|---|------------------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|-----------|--|
|   |                  | 0              | 0,5<br>min  | 1<br>min    | 1,5<br>min  | 2<br>min    | 2,5<br>min  | 3<br>min    | 3,5<br>min  | 4<br>min    | 4,5<br>min  | 5<br>min    | J/c<br>m<br>2 |           |  |
| <b>Lamp</b>   | <b>400-518</b>   | 13.<br>69      | 13.1<br>1   | 13.0<br>1   | 12.8<br>4   | 12.6<br>4   | 12.7<br>2   | 12.9<br>1   | 12.4<br>8   | 12.7<br>0   | 12.9<br>3   | 13.0<br>8   | 3.8<br>7      | 96.<br>6% |  |
| <b>Fluoresc.</b>  | <b>519-760</b>   | 0.4<br>9       | 0.47        | 0.46        | 0.45        | 0.44        | 0.44        | 0.44        | 0.43        | 0.43        | 0.43        | 0.43        | 0.1<br>3      | 3.4<br>%  |  |
| <b>total</b>  | <b>400-760</b>   | 14.<br>180     | 13.5<br>740 | 13.4<br>648 | 13.2<br>915 | 13.0<br>874 | 13.1<br>651 | 13.3<br>507 | 12.9<br>126 | 13.1<br>337 | 13.3<br>568 | 13.5<br>093 | 4.0<br>1      | 99.<br>9% |  |
| <b>%fluorescence</b>                                      |                  | 3.5<br>%       | 3.4<br>%    | 3.4<br>%    | 3.4<br>%    | 3.4<br>%    | 3.4<br>%    | 3.3<br>%    | 3.4<br>%    | 3.3<br>%    | 3.2<br>%    | 3.2<br>%    | 0.0<br>3      | 3.4<br>%  |  |
| <b>purple</b>   | <b>(400)-450</b> | 9.6<br>291     | 9.06<br>82  | 8.92<br>11  | 8.73<br>98  | 8.55<br>35  | 8.54<br>59  | 8.60<br>49  | 8.29<br>40  | 8.37<br>81  | 8.47<br>11  | 8.53<br>91  | 2.6<br>2      | 65.<br>3% |  |
| <b>Blue</b>   | <b>450-500</b>   | 4.0<br>575     | 4.04<br>08  | 4.08<br>50  | 4.10<br>40  | 4.09<br>14  | 4.17<br>46  | 4.30<br>91  | 4.18<br>39  | 4.32<br>31  | 4.45<br>81  | 4.54<br>27  | 1.2<br>5      | 31.<br>3% |  |

|               |                |                          |                    |                   |                   |                   |                   |                   |                   |                   |                   |                   |                        |                         |
|---------------|----------------|--------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------------|-------------------------|
| <b>Green</b>  | <b>500-570</b> | 0.0<br>000               | 0.00<br>00         | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | 0.00<br>00        | <b>0.0</b><br><b>0</b> | 0.0<br>%                |
| <b>Yellow</b> | <b>570-591</b> | 0.0<br>456               | 0.03<br>74         | 0.03<br>62        | 0.03<br>50        | 0.03<br>32        | 0.03<br>25        | 0.03<br>12        | 0.03<br>09        | 0.03<br>08        | 0.02<br>94        | 0.02<br>96        | <b>0.0</b><br><b>1</b> | 0.3<br>%                |
| <b>Orange</b> | <b>591-610</b> | 0.1<br>404               | 0.12<br>64         | 0.12<br>43        | 0.12<br>15        | 0.12<br>01        | 0.11<br>97        | 0.11<br>58        | 0.11<br>54        | 0.11<br>57        | 0.11<br>33        | 0.11<br>39        | <b>0.0</b><br><b>4</b> | 0.9<br>%                |
| <b>Red</b>    | <b>610-760</b> | 0.3<br>167               | 0.30<br>91         | 0.30<br>61        | 0.29<br>89        | 0.29<br>69        | 0.30<br>00        | 0.29<br>72        | 0.29<br>59        | 0.29<br>33        | 0.29<br>22        | 0.29<br>13        | <b>0.0</b><br><b>9</b> | 2.3<br>%                |
| <b>total</b>  |                | <b>14.<br/>(400-700)</b> | <b>13.5<br/>19</b> | <b>13.4<br/>8</b> | <b>13.3<br/>7</b> | <b>13.1<br/>0</b> | <b>13.1<br/>7</b> | <b>13.3<br/>6</b> | <b>12.9<br/>2</b> | <b>13.1<br/>4</b> | <b>13.3<br/>6</b> | <b>13.5<br/>2</b> | <b>4.0<br/>1</b>       | <b>100<br/>.0<br/>%</b> |

Table 30: Color Breakdown for fluorescence emission of nylon fibers

| Color  | Fiber 12 | Fiber 13 | Fiber 14 | Fiber 15 |
|--------|----------|----------|----------|----------|
| Purple | 2.51     | 2.25     | 2.47     | 2.44     |
| Blue   | 1.21     | 1.05     | 1.07     | 1.07     |
| Green  | 0.45     | 0.46     | 0.41     | 0.27     |
| Yellow | 0.45     | 0.45     | 0.38     | 0.42     |
| Orange | 0.30     | 0.30     | 0.25     | 0.32     |
| Red    | 0.41     | 0.42     | 0.35     | 0.42     |

5 Table 31: Color Breakdown for fluorescence emission of PBT fibers

| Color  | Fiber 16 | Fiber 17 | Fiber 18 | Fiber 19 | Fiber 20 |
|--------|----------|----------|----------|----------|----------|
| Purple | 12.13    | 0.47     | 0.17     | 0.19     | 0.78     |
| Blue   | 8.37     | 0.22     | 0.09     | 0.10     | 0.44     |
| Green  | 0.05     | 0.02     | 0.01     | 0.01     | 0.02     |
| Yellow | 0.00     | 0.14     | 0.10     | 0.10     | 0.12     |
| Orange | 0.00     | 0.19     | 0.13     | 0.13     | 0.17     |
| Red    | 0.00     | 0.44     | 0.32     | 0.33     | 0.41     |

Table 32: Color Breakdown for fluorescence emission of PMMA fibers

| Color  | Fiber 21 | Fiber 22 | Fiber 23 | Fiber 24 |
|--------|----------|----------|----------|----------|
| Purple | 2.21     | 2.97     | 2.68     | 2.62     |
| Blue   | 0.78     | 1.41     | 1.24     | 2.25     |
| Green  | 0.00     | 0.00     | 0.00     | 0.00     |
| Yellow | 0.03     | 0.02     | 0.02     | 0.01     |
| Orange | 0.06     | 0.06     | 0.05     | 0.04     |
| Red    | 0.10     | 0.12     | 0.12     | 0.09     |

The influence of the polymer on the fluorescence emitted by the fibers was measured and compared between the various fibers prepared. The results are presented in Figure 2D. The data shows that fibers made from polyethylene and PBT fluoresce the most.

5 Table 33: Color Breakdown for fluorescence emission of the indicated fibers

| Color  | Polyethylene | Polylactic Acid | Polypropylene | Nylon | PBT  | PMMA |
|--------|--------------|-----------------|---------------|-------|------|------|
| Purple | 8.81         | 2.95            | 7.32          | 2.51  | 0.47 | 2.21 |
| Blue   | 5.08         | 1.47            | 4.00          | 1.21  | 0.22 | 0.78 |
| Green  | 0.01         | 0.03            | 0.01          | 0.45  | 0.02 | 0.00 |
| Yellow | 0.00         | 0.08            | 0.00          | 0.45  | 0.14 | 0.03 |
| Orange | 0.00         | 0.09            | 0.00          | 0.30  | 0.19 | 0.06 |
| Red    | 0.01         | 0.09            | 0.00          | 0.41  | 0.44 | 0.10 |

*EXAMPLE 4*  
*Leaching of photoactivatable agent out of photoactivatable fibers*

10 The purpose of this experiment was to determine whether the polymer has an effect on the leaching of the photoactivatable agent out of the photoactivatable fibers. Leaching was measured by placing 0.1g of fiber in 10ml of water for 1 day following which the water was assessed for the presence of photoactivatable agent. Figure 3 shows the leaching of Eosin out of the photoactivatable fibers as defined in Example 3. The detection limit for samples in Figure 4 was 0.0095 µg/ml. Table 34 outlines the data obtained during this experiment.

15 The data presented in Table 34 and illustrated in Figure 3 demonstrates that photoactivatable fibers made from polyethylene and photoactivatable fibers made from PBT present the least leaching of Eosin amongst the polymers tested. The data also show that compounding the photoactivatable agent with the polymer of the fiber leads to substantially no leaching of the

20 photoactivatable agent out of the photoactivatable fiber.

Table 34: Leaching of Eosin out of photoactivatable fibers as defined in Example 3

| Photoactivatable Fiber | Photoactivatable agent | Concentration in solution (ppm) | % leaching |
|------------------------|------------------------|---------------------------------|------------|
| 1                      | Compounded             | 0.103                           | 0.454      |
| 2                      | Compounded             | 0.116                           | 0.510      |
| 3                      | Compounded             | 0.154                           | 0.676      |
| 4                      | Compounded and coated  | 0.351                           | 1.544      |
| 5                      | Compounded             | 0.046                           | 0.102      |
| 6                      | Compounded             | 0.046                           | 0.102      |

|    |                       |          |           |
|----|-----------------------|----------|-----------|
| 7  | Compounded            | 0.041    | 0.090     |
| 8  | Compounded            | 0.048    | 0.211     |
| 9  | Compounded            | 0.041    | 0.183     |
| 10 | Compounded            | 0.049    | 0.214     |
| 11 | Compounded and coated | 0.546    | 2.404     |
| 12 | Compounded            | 0.022    | 0.099     |
| 13 | Compounded            | 0.017    | 0.074     |
| 14 | Compounded            | 0.065    | 0.286     |
| 15 | Compounded and coated | 0.899    | 3.957     |
| 17 | Compounded            | BDL      | N/A       |
| 18 | Compounded            | BDL      | N/A       |
| 19 | Compounded            | BDL      | N/A       |
| 20 | Compounded and coated | 0.184337 | 0.4055414 |
| 21 | Compounded            | 0.102    | 0.224     |
| 22 | Compounded            | 0.118    | 0.261     |
| 23 | Compounded            | 0.184    | 0.405     |
| 24 | Compounded and coated | 1.495    | 3.290     |

### EXAMPLE 5

#### *Effect of varying lamp height on fluorescence emitted by photoactivatable fibers*

5 The purpose of this experiment was to determine the effect of varying the blue lamp height on fluorescence emission of the photoactivatable fibers. Measurements are presented in Tables 35-38 below.

Table 35: Blue lamp output

| Height (cm) | Energy (J/cm <sup>2</sup> ) | Change in height | Change in energy | Percent Energy increase |
|-------------|-----------------------------|------------------|------------------|-------------------------|
| 5           | 30.43                       |                  |                  |                         |
| 3.75        | 39.15                       | -1.25            | 8.72             | 22.28                   |
| 2.5         | 49.78                       | -1.25            | 10.63            | 21.35                   |

10

Table 36: Influence of height of blue lamp from nylon photoactivatable fibers on fluorescence emission

| Height (cm) | 0-5 minutes                 |                  |                  |                         | 5-10 minutes                |                  |                  |                         |
|-------------|-----------------------------|------------------|------------------|-------------------------|-----------------------------|------------------|------------------|-------------------------|
|             | Energy (J/cm <sup>2</sup> ) | Change in height | Change in energy | Percent Energy increase | Energy (J/cm <sup>2</sup> ) | Change in height | Change in energy | Percent Energy increase |
| 5           | 1.59                        |                  |                  |                         | 1.02                        |                  |                  |                         |
| 3.75        | 1.64                        | -1.25            | 0.05             | 3.19                    | 0.96                        | -1.25            | -0.06            | -6.60                   |
| 2.5         | 1.90                        | -1.25            | 0.26             | 15.66                   | 1.09                        | -1.25            | 0.13             | 13.83                   |

Table 37: Influence of height of blue lamp from PBT photoactivatable fibers on fluorescence emission

| Height<br>(cm) | 0-5 minutes                    |                     |                     |                               | 5-10 minutes                   |                     |                     |                               |
|----------------|--------------------------------|---------------------|---------------------|-------------------------------|--------------------------------|---------------------|---------------------|-------------------------------|
|                | Energy<br>(J/cm <sup>2</sup> ) | Change<br>in height | Change in<br>energy | Percent<br>Energy<br>increase | Energy<br>(J/cm <sup>2</sup> ) | Change<br>in height | Change in<br>energy | Percent<br>Energy<br>increase |
| 5              | 0.77                           |                     |                     |                               | 0.67                           |                     |                     |                               |
| 2.5            | 1.04                           | -2.50               | 0.28                | 26.54                         | 0.80                           | -2.50               | 0.13                | 19.88                         |

Table 38: Influence of height of blue lamp from PLA photoactivatable fibers on fluorescence emission

| Height<br>(cm) | 0-5 minutes                    |                     |                     |                               | 5-10 minutes                   |                     |                     |                               |
|----------------|--------------------------------|---------------------|---------------------|-------------------------------|--------------------------------|---------------------|---------------------|-------------------------------|
|                | Energy<br>(J/cm <sup>2</sup> ) | Change<br>in height | Change in<br>energy | Percent<br>Energy<br>increase | Energy<br>(J/cm <sup>2</sup> ) | Change<br>in height | Change in<br>energy | Percent<br>Energy<br>increase |
| 5              | 0.28                           |                     |                     |                               | 0.24                           |                     |                     |                               |
| 2.5            | 0.39                           | -2.50               | 0.11                | 27.25                         | 0.25                           | -2.50               | 0.01                | 2.83                          |

5 As the blue lamp height decreases, the fluorescence and the energy produced by the photoactivatable fiber increases in a non-linear fashion. For nylon fibers, the effect is seen in the first five minutes. The fluorescence and energy are 12.95 mW/cm<sup>2</sup> for fluorescence and 1.90 J/cm<sup>2</sup> for energy. After five minutes, it was observed that the fluorescence and the energy were similar. For PBT fibers, decreasing the lamp height increases both fluorescence  
10 and energy. However, photobleaching occurs more rapidly. For PLA fibers, decreasing the lamp height increases fluorescence at first. Photobleaching occurs at a rate such that after 7 minutes the fluorescence is lower when the lamp is closer.

#### EXAMPLE 6

##### *Effect of addition of a lubricant on the fluorescence emitted from Eosin Y*

15

The purpose of this experiment was to assess if addition of a lubricant affects the emission of fluorescence of a solution of Eosin Y. When lurol oil is added to a solution of Eosin Y in water the solution immediately turns from an orange color to a pink color. It also may get slightly bubbly. A quick check of the solution with lurol oil shows that the solution is one layer, completely miscible, with no visible precipitate. The effect of lurol oil was compared by adding 320 µL to a 2 mL solution of 109 µg/g Eosin Y. The no lurol oil solution had 320 µL of water added. The fluorescence of these two solutions was measured to determine if the lurol oil had any effect (Figure 4). The results indicated that the lurol oil has an effect  
20

of the Eosin Y solution, as the lurol oil solution was almost twice as fluorescent and barely photodegraded. Also, the fluorescence of the lurol oil is red shifted, such that some yellow and orange are observed. Under the blue lamp the lurol oil solution looks almost orange, while the solution without lurol oil was green.

5

*Example 7*  
*Effect of addition of a lubricant on the fluorescence emission  
of photoactivatable fibers*

10 The presence of a lubricant was shown to have an effect on the doped fibers and their fluorescence. In the case of low concentrations of chromophore it can slightly red shift, and reduces bleaching time considerably. In higher concentrations of chromophore it red shifts, as well as increase fluorescence. The most effect seems to be around 10g/L of lurol oil. Initially the fluorescence of Eosin Y doped fibers was 0.01 (Figure 5A), but with the lurol  
15 oil added the fluorescence is boosted to 0.7. A comparison was done of Eosin Y and Fluorescein at the same concentration with lurol oil added. It would appear that while they start out similarly in fluorescence, the fluorescein photo-degrades faster (Figure 5B).

*EXAMPLE 8*  
20 *Preparation of photoactivatable fibers with multiple layers of photoactivatable agents*

The purpose of this experiment was to determine if adding more than one layer of photoactivatable agents onto the polymeric fibers affect the emission of fluorescence. For this, the following photoactivatable fibers were prepared. The polypropylene polymer was  
25 compounded with the photoactivatable agent (Eosin Y:fluorescein) at around 0.8-1.0% w/w and the polymer was then hardened and cut into small pieces. This polymer was processed into the hopper and it was extruded into a fiber at specific micron sizes (Figure 6A: 31 microns) (Figure 6B: 93 microns). As it was exiting from the machine head, it was sprayed with a composition of lurol oil alone, or with a composition of lurol oil and photoactivatable  
30 agent, or with a composition of lurol oil and urea peroxide, or with a composition of lurol oil and sodium bicarbonate.

The amount of fluorophore is determinant for overall fluorescence of the photoactivatable fibers. As the layer level increases the overall fluorescence also increases. The increase is

not linear, and doubling the fiber content does not double the fluorescence. It is clear however that 6 layers out preforms both 4 and 2 layers of the same material.

*EXAMPLE 9*

*Influence of with multiple layers of photoactivatable agents on fluorescence emission*

5

When the chromophore is situated on the surface of the polymeric fibers, increasing the number of layers also increases the fluorescence of the polymeric fiber. When the chromophore is on the inside, the opposite happens, increasing the number of layers decreases overall fluorescence. The photoactivatable fibers were prepared as described in 10 Example 8. Photobleaching occurs more rapidly when the chromophore is on the inside (Figure 7). When comparing the 4 layer 50 g/L Eosin Y Outer from Trial 2 and 4 layer 0,5% Eosin Y Inner from Trial 3, the rate of photobleaching is faster when Eosin Y is compounded with nylon. Nylon trial 3 was more successful than nylon trial 2. With less 15 chromophore within the fiber and with less layers, it fluoresced more than with the chromophore coating the fiber. However, photobleaching occurs at a much faster rate. A difference of 2 mW/cm<sup>2</sup> is observed between them after 10 minutes.

Table 39: Color breakdown of the fluorescence emitted

| Color  | Trial 2<br>4 layers<br>50 g/L Eosin Y | Trial 2<br>2 layers<br>50 g/L E:F | Trial 2<br>4 layers<br>50 g/L E:F | Trial 3<br>2 layers<br>0,5% Eosin Inner<br>Lurol Oil Outer | Trial 3<br>4 layers<br>0,5% Eosin Inner<br>Lurol Oil Outer |
|--------|---------------------------------------|-----------------------------------|-----------------------------------|--|--|
| Purple | 2.63                                  | 6.21                              | 1.87                              | 2.51   | 0.29   |
| Blue   | 1.27                                  | 3.49                              | 0.90                              | 1.21   | 0.08   |
| Green  | 0.22                                  | 0.32                              | 0.31                              | 0.45   | 0.21   |
| Yellow | 0.56                                  | 0.47                              | 0.66                              | 0.45   | 0.35   |
| Orange | 0.44                                  | 0.34                              | 0.51                              | 0.30   | 0.26   |
| Red    | 0.50                                  | 0.27                              | 0.60                              | 0.41   | 0.41   |

Table 40: Nylon Run 1-103 microns E/F 10g/L- 4 Layers 0-5min

| Nylon Run 1-103 microns<br>E/F 10g/L- 4 Layers 0-5min |         | mW/cm <sup>2</sup> at 5cm |             |             |             |             |             |             |             |             |             |             |            | J/c<br>m <sup>2</sup> |
|---|---------|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|-----------------------|
|   |         | 0                         | 0,5<br>min  | 1<br>min    | 1,5<br>min  | 2<br>min    | 2,5<br>min  | 3<br>min    | 3,5<br>min  | 4<br>min    | 4,5<br>min  | 5<br>min    |            |                       |
| Lamp  | 400-518 | 21.4<br>7                 | 24.9<br>9   | 25.7<br>9   | 26.3<br>1   | 26.8<br>3   | 27.2<br>2   | 27.4<br>4   | 27.6<br>9   | 27.9<br>5   | 28.2<br>1   | 28.3<br>6   | 7.9<br>2   | 87.0%                 |
| Fluoresc.   | 519-760 | 3.12<br>833               | 5.17<br>593 | 4.70<br>929 | 4.34<br>514 | 4.03<br>597 | 3.85<br>718 | 3.68<br>192 | 3.53<br>143 | 3.49<br>335 | 3.32<br>293 | 3.17<br>312 | 1.1<br>9.0 | 12.9%                 |
| total   | 400-760 | 24.5<br>8                 | 30.1<br>5   | 30.4<br>7   | 30.6<br>4   | 30.8<br>2   | 31.0<br>8   | 31.1<br>1   | 31.2<br>9   | 31.4<br>6   | 31.5<br>8   | 31.5<br>8   | 9.0<br>9   | 99.9%                 |
| %fluorescenc  | e       | 12.7<br>%                 | 17.1<br>%   | 15.4<br>%   | 14.2<br>%   | 13.1<br>%   | 12.4<br>%   | 11.8<br>%   | 11.3<br>%   | 11.1<br>%   | 10.5<br>%   | 10.0<br>%   | 0.1<br>3   | 12.9%                 |

|               |                  |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                        |                                    |
|---------------|------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|------------------------------------|
| <b>purple</b> | <b>(400)-450</b> | 14.2<br>387             | 15.8<br>609             | 16.1<br>645             | 16.2<br>767             | 16.4<br>031             | 16.5<br>001             | 16.5<br>381             | 16.5<br>781             | 16.6<br>734             | 16.7<br>323             | 16.7<br>269             | <b>4.8</b><br><b>6</b> | 53.<br>4%                          |
| <b>Blue</b>   | <b>450-500</b>   | 7.22<br>85              | 8.98<br>35              | 9.49<br>86              | 9.91<br>58              | 10.3<br>133             | 10.6<br>121             | 10.7<br>933             | 11.0<br>066             | 11.1<br>705             | 11.3<br>788             | 11.5<br>401             | <b>3.0</b><br><b>3</b> | 33.<br>3%                          |
| <b>Green</b>  | <b>500-570</b>   | 1.23<br>02              | 2.14<br>14              | 1.95<br>67              | 1.71<br>72              | 1.59<br>57              | 1.52<br>91              | 1.46<br>69              | 1.41<br>55              | 1.39<br>95              | 1.33<br>50              | 1.28<br>53              | <b>0.4</b><br><b>7</b> | 5.2<br>%                           |
| <b>Yellow</b> | <b>570-591</b>   | 1.10<br>34              | 1.43<br>59              | 1.30<br>37              | 1.15<br>19              | 1.06<br>79              | 1.01<br>19              | 0.97<br>49              | 0.93<br>67              | 0.91<br>09              | 0.86<br>37              | 0.83<br>09              | <b>0.3</b><br><b>2</b> | 3.5<br>%                           |
| <b>Orange</b> | <b>591-610</b>   | 0.62<br>07              | 0.87<br>40              | 0.79<br>01              | 0.75<br>54              | 0.70<br>05              | 0.66<br>57              | 0.63<br>91              | 0.61<br>34              | 0.59<br>87              | 0.56<br>62              | 0.54<br>42              | <b>0.2</b><br><b>0</b> | 2.2<br>%                           |
| <b>Red</b>    | <b>610-760</b>   | 0.18<br>14              | 0.89<br>65              | 0.80<br>84              | 0.86<br>45              | 0.80<br>71              | 0.77<br>95              | 0.73<br>24              | 0.68<br>83              | 0.70<br>45              | 0.67<br>60              | 0.62<br>55              | <b>0.2</b><br><b>1</b> | 2.4<br>%                           |
| <b>total</b>  | <b>(400-700)</b> | <b>24.6</b><br><b>0</b> | <b>30.1</b><br><b>9</b> | <b>30.5</b><br><b>2</b> | <b>30.6</b><br><b>8</b> | <b>30.8</b><br><b>9</b> | <b>31.1</b><br><b>0</b> | <b>31.1</b><br><b>4</b> | <b>31.2</b><br><b>4</b> | <b>31.4</b><br><b>6</b> | <b>31.5</b><br><b>5</b> | <b>31.5</b><br><b>5</b> | <b>9.1</b><br><b>0</b> | <b>100</b><br><b>0</b><br><b>%</b> |

Table 41: Nylon Run 1-103 microns E/F 20g/L- 4 Layers 0-5min

| Nylon Run 1-103 microns<br>E/F 20g/L- 4 Layers 0-5min |                  | mW/cm2 at 5cm                         |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                                       |                        |                                    |
|---|------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------------|------------------------------------|
|   |                  | 0                                     | 0,5<br>min                            | 1<br>min                              | 1,5<br>min                            | 2<br>min                              | 2,5<br>min                            | 3<br>min                              | 3,5<br>min                            | 4<br>min                              | 4,5<br>min                            | 5<br>min                              | J/c<br>m2              |                                    |
| <b>Lamp</b>   | <b>400-518</b>   | 19.4<br>0                             | 21.2<br>7                             | 22.6<br>7                             | 22.7<br>7                             | 23.1<br>3                             | 23.6<br>7                             | 24.1<br>1                             | 24.5<br>1                             | 24.9<br>2                             | 25.3<br>0                             | 25.5<br>7                             | <b>6.9</b><br><b>5</b> | 80.<br>2%                          |
| <b>Fluoresc.</b>                                      | <b>519-760</b>   | 7.72                                  | 6.40                                  | 5.79                                  | 5.81                                  | 5.63                                  | 5.45                                  | 5.18                                  | 5.03                                  | 4.87                                  | 4.75                                  | 4.66                                  | <b>1.7</b><br><b>0</b> | 19.<br>6%                          |
| <b>total</b>  | <b>400-760</b>   | <b>27.1</b><br><b>214</b><br><b>1</b> | <b>27.6</b><br><b>737</b><br><b>5</b> | <b>28.4</b><br><b>575</b><br><b>6</b> | <b>28.5</b><br><b>804</b><br><b>8</b> | <b>28.7</b><br><b>646</b><br><b>1</b> | <b>29.1</b><br><b>285</b><br><b>2</b> | <b>29.2</b><br><b>912</b><br><b>8</b> | <b>29.5</b><br><b>368</b><br><b>6</b> | <b>29.7</b><br><b>940</b><br><b>2</b> | <b>30.0</b><br><b>486</b><br><b>2</b> | <b>30.2</b><br><b>224</b><br><b>7</b> | <b>8.6</b><br><b>5</b> | 99.<br>9%                          |
| <b>%fluorescenc e</b>                                 |                  | 28.5<br>%                             | 23.1<br>%                             | 20.4<br>%                             | 20.3<br>%                             | 19.6<br>%                             | 18.7<br>%                             | 17.7<br>%                             | 17.0<br>%                             | 16.4<br>%                             | 15.8<br>%                             | 15.4<br>%                             | <b>0.2</b><br><b>0</b> | 19.<br>6%                          |
| <b>purple</b>   | <b>(400)-450</b> | 12.6<br>847                           | 13.4<br>080                           | 14.0<br>379                           | 14.1<br>004                           | 14.2<br>567                           | 14.5<br>022                           | 14.6<br>514                           | 14.8<br>214                           | 14.9<br>772                           | 15.1<br>395                           | 15.2<br>521                           | <b>4.2</b><br><b>8</b> | 49.<br>4%                          |
| <b>Blue</b>   | <b>450-500</b>   | 6.63<br>70                            | 7.79<br>65                            | 8.56<br>87                            | 8.60<br>18                            | 8.81<br>39                            | 9.10<br>72                            | 9.40<br>21                            | 9.63<br>11                            | 9.88<br>33                            | 10.0<br>927                           | 10.2<br>565                           | <b>2.6</b><br><b>6</b> | 30.<br>7%                          |
| <b>Green</b>  | <b>500-570</b>   | 2.23<br>66                            | 1.87<br>97                            | 1.69<br>72                            | 1.70<br>04                            | 1.65<br>93                            | 1.60<br>50                            | 1.53<br>66                            | 1.49<br>34                            | 1.46<br>25                            | 1.43<br>31                            | 1.40<br>59                            | <b>0.5</b><br><b>0</b> | 5.8<br>%                           |
| <b>Yellow</b>   | <b>570-591</b>   | 2.42<br>98                            | 1.98<br>11                            | 1.78<br>22                            | 1.77<br>86                            | 1.72<br>44                            | 1.65<br>95                            | 1.58<br>91                            | 1.54<br>02                            | 1.48<br>79                            | 1.44<br>29                            | 1.41<br>63                            | <b>0.5</b><br><b>2</b> | 6.0<br>%                           |
| <b>Orange</b>   | <b>591-610</b>   | 1.55<br>72                            | 1.28<br>61                            | 1.16<br>26                            | 1.15<br>94                            | 1.12<br>50                            | 1.08<br>24                            | 1.03<br>51                            | 1.00<br>43                            | 0.96<br>87                            | 0.93<br>94                            | 0.91<br>80                            | <b>0.3</b><br><b>4</b> | 3.9<br>%                           |
| <b>Red</b>  | <b>610-760</b>   | 1.63<br>40                            | 1.37<br>11                            | 1.25<br>34                            | 1.28<br>32                            | 1.22<br>80                            | 1.21<br>35                            | 1.11<br>67                            | 1.08<br>42                            | 1.05<br>17                            | 1.03<br>68                            | 1.00<br>80                            | <b>0.3</b><br><b>7</b> | 4.2<br>%                           |
| <b>total</b>  | <b>(400-700)</b> | <b>27.1</b><br><b>8</b>               | <b>27.7</b><br><b>2</b>               | <b>28.5</b><br><b>0</b>               | <b>28.6</b><br><b>2</b>               | <b>28.8</b><br><b>1</b>               | <b>29.1</b><br><b>7</b>               | <b>29.3</b><br><b>3</b>               | <b>29.5</b><br><b>7</b>               | <b>29.8</b><br><b>3</b>               | <b>30.0</b><br><b>8</b>               | <b>30.2</b><br><b>6</b>               | <b>8.6</b><br><b>6</b> | <b>100</b><br><b>0</b><br><b>%</b> |

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Table 42: Nylon Run 7 Fluorescein 35g/L- 4 Layers 0-5min

| Nylon Run 7 Fluorescein<br>35g/L- 4 Layers 0-5min |                | mW/cm2 at 5cm |              |              |              |              |              |              |              |           |             |           |                        |           |
|---|----------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------|-------------|-----------|------------------------|-----------|
|   |                | 0             | 0,5<br>min   | 1<br>min     | 1,5<br>min   | 2<br>min     | 2,5<br>min   | 3<br>min     | 3,5<br>min   | 4<br>min  | 4,5<br>min  | 5<br>min  | J/c<br>m2              |           |
| <b>Lamp</b>                                       | <b>400-518</b> | 10.6<br>8     | 11.9<br>2    | 12.8<br>9    | 13.6<br>3    | 14.3<br>3    | 14.9<br>5    | 15.6<br>0    | 16.2<br>1    | 16.7<br>1 | 17.<br>21   | 17.6<br>1 | <b>4.3</b><br><b>2</b> | 65.<br>4% |
| <b>Fluoresc.</b>                                  | <b>519-760</b> | 10.3<br>0     | 9.13<br>9.13 | 8.49<br>8.49 | 8.01<br>7.59 | 7.59<br>7.16 | 7.16<br>6.83 | 6.83<br>6.42 | 6.42<br>6.17 | 5.8<br>8  | 5.8<br>5.65 | 5.65<br>8 | <b>2.2</b><br><b>8</b> | 34.<br>5% |

|                      |                  |               |               |               |               |               |               |               |               |               |               |               |             |               |
|----------------------|------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------|---------------|
| <b>total</b>         | <b>400-760</b>   | <b>20.9</b>   | <b>21.0</b>   | <b>21.3</b>   | <b>21.6</b>   | <b>21.9</b>   | <b>22.1</b>   | <b>22.4</b>   | <b>22.6</b>   | <b>22.8</b>   | <b>23.</b>    | <b>23.2</b>   | <b>6.6</b>  | <b>99.9%</b>  |
| <b>%fluorescence</b> |                  | <b>49.1%</b>  | <b>43.4%</b>  | <b>39.7%</b>  | <b>37.0%</b>  | <b>34.6%</b>  | <b>32.4%</b>  | <b>30.4%</b>  | <b>28.4%</b>  | <b>27.0%</b>  | <b>25.5%</b>  | <b>24.3%</b>  | <b>0.35</b> | <b>34.5%</b>  |
| <b>purple</b>        | <b>(400)-450</b> | <b>6.7401</b> | <b>7.2458</b> | <b>7.6859</b> | <b>8.0035</b> | <b>8.3020</b> | <b>8.5583</b> | <b>8.8489</b> | <b>9.0966</b> | <b>9.3179</b> | <b>9.5100</b> | <b>9.6820</b> | <b>2.50</b> | <b>37.8%</b>  |
| <b>Blue</b>          | <b>450-500</b>   | <b>3.5037</b> | <b>4.2174</b> | <b>4.7250</b> | <b>5.1256</b> | <b>5.5065</b> | <b>5.8505</b> | <b>6.2007</b> | <b>6.5468</b> | <b>6.8184</b> | <b>7.1173</b> | <b>7.3422</b> | <b>1.67</b> | <b>25.2%</b>  |
| <b>Green</b>         | <b>500-570</b>   | <b>6.4483</b> | <b>5.8166</b> | <b>5.4777</b> | <b>5.2332</b> | <b>5.0226</b> | <b>4.8153</b> | <b>4.6339</b> | <b>4.4415</b> | <b>4.3017</b> | <b>4.1459</b> | <b>4.0237</b> | <b>1.51</b> | <b>22.8%</b>  |
| <b>Yellow</b>        | <b>570-591</b>   | <b>1.8820</b> | <b>1.6354</b> | <b>1.4990</b> | <b>1.3971</b> | <b>1.3096</b> | <b>1.2236</b> | <b>1.1540</b> | <b>1.0778</b> | <b>1.0244</b> | <b>0.9718</b> | <b>0.9246</b> | <b>0.40</b> | <b>6.0%</b>   |
| <b>Orange</b>        | <b>591-610</b>   | <b>1.0807</b> | <b>0.9469</b> | <b>0.8767</b> | <b>0.8197</b> | <b>0.7732</b> | <b>0.7270</b> | <b>0.6870</b> | <b>0.6431</b> | <b>0.6127</b> | <b>0.5811</b> | <b>0.5564</b> | <b>0.23</b> | <b>3.5%</b>   |
| <b>Red</b>           | <b>610-760</b>   | <b>1.3665</b> | <b>1.2324</b> | <b>1.1575</b> | <b>1.0932</b> | <b>1.0361</b> | <b>0.9634</b> | <b>0.9312</b> | <b>0.8515</b> | <b>0.8318</b> | <b>0.7831</b> | <b>0.7505</b> | <b>0.31</b> | <b>4.6%</b>   |
| <b>total</b>         | <b>(400-700)</b> | <b>21.02</b>  | <b>21.09</b>  | <b>21.42</b>  | <b>21.67</b>  | <b>21.95</b>  | <b>22.14</b>  | <b>22.46</b>  | <b>22.66</b>  | <b>22.91</b>  | <b>23.11</b>  | <b>23.28</b>  | <b>6.61</b> | <b>100.0%</b> |

Table 43: Nylon Run 9C-103 microns E/F 30/7.5/7.5- 4 Layers 0-5min

| Nylon Run 9C-103 microns<br>E/F 30/7.5/7.5- 4 Layers 0-<br>5min |                  | mW/cm2 at 5cm   |                 |                 |                |                |                |                |                |                |                |                |             |               |
|---|------------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|---------------|
|   |                  | 0               | 0,5 min         | 1 min           | 1,5 min        | 2 min          | 2,5 min        | 3 min          | 3,5 min        | 4 min          | 4,5 min        | 5 min          | J/cm2       |               |
| <b>Lamp</b>   | <b>400-518</b>   | <b>20.92</b>    | <b>21.07</b>    | <b>21.36</b>    | <b>21.56</b>   | <b>21.77</b>   | <b>21.82</b>   | <b>21.92</b>   | <b>22.02</b>   | <b>22.17</b>   | <b>22.33</b>   | <b>22.48</b>   | <b>6.51</b> | <b>94.0%</b>  |
| <b>Fluoresc.</b>  | <b>519-760</b>   | <b>1.54</b>     | <b>1.41</b>     | <b>1.39</b>     | <b>1.36</b>    | <b>1.36</b>    | <b>1.34</b>    | <b>1.34</b>    | <b>1.33</b>    | <b>1.29</b>    | <b>1.31</b>    | <b>1.30</b>    | <b>0.41</b> | <b>5.9%</b>   |
| <b>total</b>  | <b>400-760</b>   | <b>22.45942</b> | <b>22.48255</b> | <b>22.74403</b> | <b>22.9241</b> | <b>23.1252</b> | <b>23.19</b>   | <b>23.2614</b> | <b>23.3500</b> | <b>23.4619</b> | <b>23.6425</b> | <b>23.7827</b> | <b>6.92</b> | <b>99.9%</b>  |
| <b>%fluorescence</b>  |                  | <b>6.9%</b>     | <b>6.3%</b>     | <b>6.1%</b>     | <b>5.9%</b>    | <b>5.9%</b>    | <b>5.8%</b>    | <b>5.8%</b>    | <b>5.7%</b>    | <b>5.5%</b>    | <b>5.5%</b>    | <b>5.5%</b>    | <b>0.06</b> | <b>5.9%</b>   |
| <b>purple</b>   | <b>(400)-450</b> | <b>14.2461</b>  | <b>14.0180</b>  | <b>14.0744</b>  | <b>14.0780</b> | <b>14.0611</b> | <b>14.0484</b> | <b>14.0565</b> | <b>14.0161</b> | <b>14.0168</b> | <b>14.0343</b> | <b>14.0449</b> | <b>4.22</b> | <b>60.9%</b>  |
| <b>Blue</b>   | <b>450-500</b>   | <b>6.6739</b>   | <b>7.0542</b>   | <b>7.2817</b>   | <b>7.4833</b>  | <b>7.7090</b>  | <b>7.7720</b>  | <b>7.8656</b>  | <b>8.0056</b>  | <b>8.1532</b>  | <b>8.3002</b>  | <b>8.4356</b>  | <b>2.29</b> | <b>33.1%</b>  |
| <b>Green</b>  | <b>500-570</b>   | <b>0.0700</b>   | <b>0.0640</b>   | <b>0.0625</b>   | <b>0.0652</b>  | <b>0.0690</b>  | <b>0.0682</b>  | <b>0.0698</b>  | <b>0.0615</b>  | <b>0.0696</b>  | <b>0.0661</b>  | <b>0.0601</b>  | <b>0.02</b> | <b>0.3%</b>   |
| <b>Yellow</b>   | <b>570-591</b>   | <b>0.3880</b>   | <b>0.3600</b>   | <b>0.3510</b>   | <b>0.3480</b>  | <b>0.3480</b>  | <b>0.3455</b>  | <b>0.3465</b>  | <b>0.3454</b>  | <b>0.3405</b>  | <b>0.3456</b>  | <b>0.3401</b>  | <b>0.11</b> | <b>1.5%</b>   |
| <b>Orange</b>   | <b>591-610</b>   | <b>0.5250</b>   | <b>0.4839</b>   | <b>0.4742</b>   | <b>0.4657</b>  | <b>0.4584</b>  | <b>0.4548</b>  | <b>0.4591</b>  | <b>0.4407</b>  | <b>0.4421</b>  | <b>0.4408</b>  | <b>0.444</b>   | <b>0.14</b> | <b>2.0%</b>   |
| <b>Red</b>  | <b>610-760</b>   | <b>0.5830</b>   | <b>0.5270</b>   | <b>0.5243</b>   | <b>0.5075</b>  | <b>0.5028</b>  | <b>0.4956</b>  | <b>0.4916</b>  | <b>0.4848</b>  | <b>0.4831</b>  | <b>0.4663</b>  | <b>0.4531</b>  | <b>0.15</b> | <b>2.2%</b>   |
| <b>total</b>  | <b>(400-700)</b> | <b>22.49</b>    | <b>22.51</b>    | <b>22.77</b>    | <b>22.95</b>   | <b>23.18</b>   | <b>23.18</b>   | <b>23.27</b>   | <b>23.37</b>   | <b>23.48</b>   | <b>23.66</b>   | <b>23.80</b>   | <b>6.93</b> | <b>100.0%</b> |

Table 44: Polypropylene Run 10 Fluorescein 35g/L- 4 Layers 0-5min

| Polypropylene Run 10<br>Fluorescein 35g/L- 4 Layers<br>0-5min |  | mW/cm2 at 5cm |         |       |         |       |         |       |         |       |         |       |       |  |
|---|--|---------------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|-------|--|
|   |  | 0             | 0,5 min | 1 min | 1,5 min | 2 min | 2,5 min | 3 min | 3,5 min | 4 min | 4,5 min | 5 min | J/cm2 |  |
|   |  |               |         |       |         |       |         |       |         |       |         |       |       |  |

|                      |                  |                     |                     |                     |                     |                     |                   |                   |                   |                   |                   |                   |                   |                          |             |
|----------------------|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------------|-------------|
| <b>Lamp</b>          | <b>400-518</b>   | 34.7<br>5           | 35.1<br>8           | 35.2<br>6           | 35.1<br>9           | 35.2<br>6           | 35.2<br>0         | 35.1<br>1         | 35.1<br>0         | 34.9<br>5         | 34.8<br>8         | 34.8<br>6         | <b>10.<br/>53</b> | 98.<br>7%                |             |
| <b>Fluoresc.</b>     | <b>519-760</b>   | 0.58                | 0.63                | 0.60                | 0.46                | 0.45                | 0.41              | 0.38              | 0.37              | 0.31              | 0.30              | 0.29              | <b>0.1<br/>3</b>  | 1.3<br>%                 |             |
| <b>total</b>         | <b>400-760</b>   | <b>35.3<br/>294</b> | <b>35.8<br/>093</b> | <b>35.8<br/>579</b> | <b>35.6<br/>573</b> | <b>35.7<br/>035</b> | <b>35.6<br/>8</b> | <b>35.4<br/>4</b> | <b>35.4<br/>8</b> | <b>35.2<br/>8</b> | <b>35.1<br/>7</b> | <b>35.1<br/>1</b> | <b>35.1<br/>4</b> | <b>10.<br/>66</b>        | 100.<br>.0% |
| <b>%fluorescence</b> |                  | 1.6<br>%            | 1.8<br>%            | 1.7<br>%            | 1.3<br>%            | 1.3<br>%            | 1.1<br>%          | 1.1<br>%          | 1.0<br>%          | 0.9<br>%          | 0.9<br>%          | 0.8<br>%          | <b>0.0<br/>1</b>  | 1.3<br>%                 |             |
| <b>purple</b>        | <b>(400)-450</b> | 21.5<br>860         | 21.4<br>518         | 21.3<br>402         | 20.8<br>147         | 20.7<br>911         | 20.6<br>313       | 20.4<br>316       | 20.3<br>492       | 20.1<br>362       | 20.0<br>194       | 19.9<br>225       | <b>6.2<br/>3</b>  | 58.<br>4%                |             |
| <b>Blue</b>          | <b>450-500</b>   | 13.0<br>286         | 13.5<br>733         | 13.7<br>616         | 14.2<br>367         | 14.3<br>212         | 14.4<br>363       | 14.5<br>448       | 14.6<br>194       | 14.6<br>803       | 14.7<br>432       | 14.8<br>173       | <b>4.2<br/>6</b>  | 39.<br>9%                |             |
| <b>Green</b>         | <b>500-570</b>   | 0.55<br>51          | 0.56<br>56          | 0.54<br>58          | 0.44<br>88          | 0.43<br>90          | 0.40<br>82        | 0.38<br>77        | 0.38<br>18        | 0.34<br>40        | 0.32<br>58        | 0.31<br>98        | <b>0.1<br/>3</b>  | 1.2<br>%                 |             |
| <b>Yellow</b>        | <b>570-591</b>   | 0.10<br>04          | 0.10<br>11          | 0.09<br>41          | 0.07<br>63          | 0.07<br>04          | 0.06<br>66        | 0.06<br>22        | 0.05<br>91        | 0.04<br>86        | 0.04<br>67        | 0.04<br>54        | <b>0.0<br/>2</b>  | 0.2<br>%                 |             |
| <b>Orange</b>        | <b>591-610</b>   | 0.04<br>77          | 0.06<br>09          | 0.05<br>77          | 0.04<br>43          | 0.04<br>41          | 0.03<br>97        | 0.03<br>69        | 0.03<br>64        | 0.02<br>89        | 0.02<br>89        | 0.02<br>73        | <b>0.0<br/>1</b>  | 0.1<br>%                 |             |
| <b>Red</b>           | <b>610-760</b>   | 0.01<br>32          | 0.05<br>90          | 0.06<br>08          | 0.03<br>82          | 0.03<br>96          | 0.02<br>82        | 0.02<br>58        | 0.02<br>71        | 0.01<br>82        | 0.01<br>97        | 0.02<br>26        | <b>0.0<br/>1</b>  | 0.1<br>%                 |             |
| <b>total</b>         | <b>(400-700)</b> | <b>35.3<br/>3</b>   | <b>35.8<br/>1</b>   | <b>35.8<br/>6</b>   | <b>35.6<br/>6</b>   | <b>35.7<br/>1</b>   | <b>35.6<br/>1</b> | <b>35.4<br/>9</b> | <b>35.4<br/>7</b> | <b>35.2<br/>6</b> | <b>35.1<br/>8</b> | <b>35.1<br/>5</b> | <b>10.<br/>66</b> | <b>100.<br/>.0<br/>%</b> |             |

Table 45: Polypropylene Run 12 Eosin y 25g/L- 4 Layers 0-5min

| Polypropylene Run 12<br>Eosin y 25g/L- 4<br>Layers 0-5min |                       | mW/cm <sup>2</sup> at 5cm |                      |                      |                      |                      |                      |                     |                      |                      |                     |                   | J/c<br>m <sup>2</sup> |                          |
|---|-----------------------|---------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|---------------------|-------------------|-----------------------|--------------------------|
|   |                       | 0                         | 0,5<br>min           | 1<br>min             | 1,5<br>min           | 2<br>min             | 2,5<br>min           | 3<br>min            | 3,5<br>min           | 4<br>min             | 4,5<br>min          | 5<br>min          |                       |                          |
| <b>Lamp</b>   | <b>400-518</b>        | 20.3<br>5                 | 20.2<br>9            | 20.2<br>7            | 20.2<br>3            | 20.1<br>9            | 20.1<br>7            | 20.1<br>2           | 20.1<br>3            | 20.0<br>9            | 20.1<br>1           | 20.0<br>9         | <b>6.0<br/>6</b>      | 96.<br>2%                |
| <b>Fluoresc.</b>  | <b>519-760</b>        | 0.84                      | 0.81                 | 0.80                 | 0.79                 | 0.78                 | 0.78                 | 0.77                | 0.77                 | 0.76                 | 0.76                | 0.76              | <b>0.2<br/>4</b>      | 3.7<br>%                 |
| <b>total</b>  | <b>400-760</b>        | <b>21.1<br/>856</b>       | <b>21.0<br/>9802</b> | <b>21.0<br/>6914</b> | <b>21.0<br/>2316</b> | <b>20.9<br/>6994</b> | <b>20.9<br/>4642</b> | <b>20.8<br/>899</b> | <b>20.8<br/>9411</b> | <b>20.8<br/>5018</b> | <b>20.8<br/>722</b> | <b>20.8<br/>2</b> | <b>523<br/>9</b>      | 6.2<br>.0%               |
| <b>%fluoresc<br/>ence</b>                                 |                       | 4.0<br>%                  | 3.8<br>%             | 3.8<br>%             | 3.8<br>%             | 3.7<br>%             | 3.7<br>%             | 3.7<br>%            | 3.7<br>%             | 3.6<br>%             | 3.7<br>%            | 3.7<br>%          | <b>0.0<br/>4</b>      | 3.7<br>%                 |
| <b>purple</b>   | <b>(400)-<br/>450</b> | 13.7<br>608               | 13.4<br>286          | 13.2<br>875          | 13.1<br>247          | 12.9<br>928          | 12.8<br>698          | 12.7<br>363         | 12.6<br>547          | 12.5<br>548          | 12.4<br>838         | 12.4<br>130       | <b>3.9<br/>0</b>      | 61.<br>9%                |
| <b>Blue</b>   | <b>450-500</b>        | 6.58<br>46                | 6.86<br>30           | 6.98<br>10           | 7.10<br>75           | 7.19<br>48           | 7.29<br>87           | 7.38<br>16          | 7.47<br>11           | 7.53<br>54           | 7.62<br>39          | 7.67<br>59        | <b>2.1<br/>6</b>      | 34.<br>3%                |
| <b>Green</b>  | <b>500-570</b>        | 0.14<br>34                | 0.14<br>14           | 0.13<br>71           | 0.13<br>56           | 0.13<br>10           | 0.12<br>87           | 0.12<br>87          | 0.12<br>58           | 0.12<br>57           | 0.12<br>61          | 0.12<br>58        | <b>0.0<br/>4</b>      | 0.6<br>%                 |
| <b>Yellow</b>   | <b>570-591</b>        | 0.29<br>80                | 0.29<br>76           | 0.29<br>57           | 0.29<br>25           | 0.29<br>02           | 0.28<br>67           | 0.28<br>54          | 0.28<br>38           | 0.28<br>35           | 0.28<br>43          | 0.28<br>41        | <b>0.0<br/>9</b>      | 1.4<br>%                 |
| <b>Orange</b>   | <b>591-610</b>        | 0.25<br>76                | 0.24<br>60           | 0.24<br>32           | 0.24<br>00           | 0.23<br>87           | 0.23<br>83           | 0.23<br>66          | 0.23<br>56           | 0.23<br>36           | 0.23<br>41          | 0.23<br>28        | <b>0.0<br/>7</b>      | 1.1<br>%                 |
| <b>Red</b>  | <b>610-760</b>        | 0.15<br>09                | 0.13<br>06           | 0.13<br>38           | 0.13<br>19           | 0.13<br>14           | 0.13<br>33           | 0.13<br>02          | 0.13<br>20           | 0.12<br>60           | 0.12<br>90          | 0.12<br>95        | <b>0.0<br/>4</b>      | 0.6<br>%                 |
| <b>total</b>  | <b>(400-<br/>700)</b> | <b>21.2<br/>0</b>         | <b>21.1<br/>1</b>    | <b>21.0<br/>8</b>    | <b>21.0<br/>3</b>    | <b>20.9<br/>8</b>    | <b>20.9<br/>6</b>    | <b>20.9<br/>0</b>   | <b>20.9<br/>0</b>    | <b>20.8<br/>6</b>    | <b>20.8<br/>8</b>   | <b>20.8<br/>6</b> | <b>6.3<br/>0</b>      | <b>100.<br/>.0<br/>%</b> |

Table 46: Polypropylene Run 15B E/F/RB 20/5/5 (g/L)- 4 Layers 0-5min

| Polypropylene Run 15B<br>E/F/RB 20/5/5 (g/L)- 4<br>Layers 0-5min |               | mW/cm2 at 5cm    |              |              |              |              |             |             |              |             |             |              |          |        |  |
|--|---------------|------------------|--------------|--------------|--------------|--------------|-------------|-------------|--------------|-------------|-------------|--------------|----------|--------|--|
|  |               | 0                | 0,5 min      | 1 min        | 1,5 min      | 2 min        | 2,5 min     | 3 min       | 3,5 min      | 4 min       | 4,5 min     | 5 min        | J/c m 2  |        |  |
| Lamp   | 400-518       | 25.4<br>1        | 25.5<br>0    | 25.5<br>9    | 25.6<br>5    | 25.7<br>2    | 25.7<br>6   | 25.8<br>0   | 25.8<br>2    | 25.8<br>5   | 25.9<br>1   | 25.9<br>4    | 7.7<br>1 | 97.2%  |  |
| Fluoresc.  | 519-760       | 0.83             | 0.78         | 0.76         | 0.74         | 0.73         | 0.72        | 0.71        | 0.70         | 0.69        | 0.68        | 0.68         | 0.2<br>2 | 2.8 %  |  |
| total  | 400-760       | 26.2<br>36<br>34 | 26.2<br>8132 | 26.3<br>4717 | 26.3<br>9618 | 26.4<br>4999 | 26.4<br>881 | 26.5<br>104 | 26.5<br>1969 | 26.5<br>395 | 26.5<br>943 | 26.6<br>2222 | 7.9<br>3 | 100.0% |  |
| %fluorescence  |               | 3.2<br>%         | 3.0<br>%     | 2.9<br>%     | 2.8<br>%     | 2.8<br>%     | 2.7<br>%    | 2.7<br>%    | 2.6<br>%     | 2.6<br>%    | 2.6<br>%    | 2.6%<br>3    | 0.0<br>3 | 2.8 %  |  |
| purple   | (400)-<br>450 | 16.5<br>08<br>05 | 16.3<br>661  | 16.2<br>357  | 16.1<br>308  | 16.0<br>312  | 15.9<br>348 | 15.8<br>525 | 15.7<br>523  | 15.7<br>119 | 15.6<br>652 | 15.6<br>041  | 4.8<br>1 | 60.6%  |  |
| Blue   | 450-500       | 8.89<br>67       | 9.13<br>25   | 9.35<br>18   | 9.52<br>09   | 9.68<br>96   | 9.82<br>91  | 9.94<br>52  | 10.0<br>682  | 10.1<br>388 | 10.2<br>448 | 10.3<br>347  | 2.9<br>0 | 36.6%  |  |
| Green  | 500-570       | 0.04<br>24       | 0.03<br>35   | 0.03<br>38   | 0.03<br>17   | 0.03<br>18   | 0.03<br>39  | 0.03<br>39  | 0.03<br>42   | 0.03<br>51  | 0.03<br>72  | 0.03<br>80   | 0.0<br>1 | 0.1 %  |  |
| Yellow   | 570-591       | 0.24<br>30       | 0.22<br>65   | 0.22<br>20   | 0.21<br>87   | 0.21<br>44   | 0.21<br>58  | 0.21<br>43  | 0.21<br>33   | 0.21<br>04  | 0.20<br>97  | 0.21<br>18   | 0.0<br>7 | 0.8 %  |  |
| Orange   | 591-610       | 0.29<br>14       | 0.27<br>97   | 0.27<br>11   | 0.26<br>57   | 0.25<br>93   | 0.25<br>77  | 0.25<br>25  | 0.24<br>97   | 0.24<br>56  | 0.24<br>09  | 0.24<br>87   | 0.0<br>8 | 1.0 %  |  |
| Red  | 610-760       | 0.26<br>76       | 0.25<br>62   | 0.24<br>55   | 0.24<br>08   | 0.23<br>58   | 0.22<br>89  | 0.22<br>37  | 0.21<br>35   | 0.20<br>88  | 0.20<br>76  | 0.20<br>58   | 0.0<br>7 | 0.9 %  |  |
| total  | (400-<br>700) | 26.2<br>5        | 26.2<br>9    | 26.3<br>6    | 26.4<br>1    | 26.4<br>6    | 26.5<br>0   | 26.5<br>2   | 26.5<br>3    | 26.5<br>5   | 26.6<br>1   | 26.6<br>3    | 7.9<br>3 | 100.0% |  |

Table 47: Polypropylene core with Polyethylene sheath, Fluorescein, 30g/L-4 Layers 0-5min

| Polypropylene core with<br>Polyethylene sheath,<br>Fluorescein, 30g/L-4<br>Layers 0-5min |               | mW/cm2 at 5cm |              |             |              |              |              |              |              |              |              |             |           |        |  |
|--|---------------|---------------|--------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|-----------|--------|--|
|  |               | 0             | 0,5 min      | 1 min       | 1,5 min      | 2 min        | 2,5 min      | 3 min        | 3,5 min      | 4 min        | 4,5 min      | 5 min       | J/ c m 2  |        |  |
| Lamp   | 400-518       | 23.1<br>0     | 24.1<br>8    | 24.2<br>9   | 24.5<br>4    | 24.8<br>9    | 25.2<br>0    | 25.3<br>3    | 25.5<br>4    | 25.6<br>8    | 25.7<br>6    | 25.7<br>83  | 7.46      | 95.1%  |  |
| Fluoresc.  | 519-760       | 1.91          | 1.56         | 1.52        | 1.43         | 1.27         | 1.16         | 1.06         | 0.99         | 0.96         | 0.88         | 0.8<br>4    | 0.38      | 4.9 %  |  |
| total  | 400-760       | 25.0<br>1102  | 25.7<br>3662 | 25.8<br>135 | 25.9<br>7069 | 26.1<br>6178 | 26.3<br>5745 | 26.3<br>9481 | 26.5<br>2577 | 26.6<br>4275 | 26.6<br>4462 | 26.6<br>04  | 669<br>84 | 10.0 % |  |
| %fluorescence  |               | 7.6<br>%      | 6.0<br>%     | 5.9<br>%    | 5.5<br>%     | 4.9<br>%     | 4.4<br>%     | 4.0<br>%     | 3.7<br>%     | 3.6<br>%     | 3.3<br>%     | 3.1<br>%    | 0.05      | 4.9 %  |  |
| purple   | (400)-<br>450 | 14.4<br>848   | 14.7<br>578  | 14.8<br>113 | 14.8<br>620  | 14.9<br>236  | 14.9<br>942  | 14.9<br>548  | 14.9<br>895  | 14.9<br>871  | 14.9<br>555  | 14.9<br>933 | 4.46      | 56.9%  |  |

|               |                        |             |                   |                   |                   |                   |                   |                   |                   |                   |                   |                  |                        |                  |                         |
|---------------|------------------------|-------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------------|------------------|-------------------------|
| <b>Blue</b>   | <b>450-500</b>         | 8.42<br>57  | 9.25<br>02        | 9.30<br>24        | 9.51<br>54        | 9.81<br>49        | 10.0<br>590       | 10.2<br>412       | 10.4<br>189       | 10.5<br>712       | 10.6<br>820       | 10.<br>780       | <b>2.</b><br><b>95</b> | 37.<br>6%        |                         |
| <b>Green</b>  | <b>500-570</b>         | 1.25<br>88  | 1.06<br>45        | 1.04<br>56        | 0.98<br>03        | 0.87<br>71        | 0.81<br>12        | 0.72<br>64        | 0.67<br>95        | 0.64<br>68        | 0.60<br>59        | 0.5<br>693       | <b>0.</b><br><b>26</b> | 3.3<br>%         |                         |
| <b>Yellow</b> | <b>570-591</b>         | 0.36<br>98  | 0.30<br>03        | 0.29<br>76        | 0.27<br>83        | 0.25<br>03        | 0.22<br>78        | 0.21<br>13        | 0.19<br>83        | 0.18<br>79        | 0.17<br>63        | 0.1<br>669       | <b>0.</b><br><b>07</b> | 1.0<br>%         |                         |
| <b>Orange</b> | <b>591-610</b>         | 0.22<br>50  | 0.17<br>84        | 0.17<br>78        | 0.16<br>35        | 0.14<br>57        | 0.13<br>34        | 0.12<br>85        | 0.11<br>96        | 0.11<br>59        | 0.10<br>82        | 0.1<br>014       | <b>0.</b><br><b>04</b> | 0.6<br>%         |                         |
| <b>Red</b>    | <b>610-760</b>         | 0.25<br>60  | 0.19<br>19        | 0.18<br>62        | 0.17<br>77        | 0.15<br>55        | 0.13<br>68        | 0.13<br>78        | 0.12<br>47        | 0.13<br>85        | 0.12<br>10        | 0.1<br>213       | <b>0.</b><br><b>05</b> | 0.6<br>%         |                         |
|               | <b>(400-<br/>total</b> | <b>700)</b> | <b>25.0<br/>2</b> | <b>25.7<br/>4</b> | <b>25.8<br/>2</b> | <b>25.9<br/>8</b> | <b>26.1<br/>7</b> | <b>26.3<br/>6</b> | <b>26.4<br/>0</b> | <b>26.5<br/>3</b> | <b>26.6<br/>5</b> | <b>26.<br/>5</b> | <b>26.<br/>67</b>      | <b>7.<br/>84</b> | <b>10<br/>0.0<br/>%</b> |

Table 48: Polypropylene core/Polyethylene sheath, E:F:RB, 20g/:5g/L:5g/L- 4 Layers 0-5min

| Polypropylene core/Polyethylene sheath, E:F:RB, 20g/:5g/L:5g/L- 4 Layers 0-5min |                       | mW/cm2 at 5cm        |                      |                      |                      |                      |                     |                      |                      |                      |                      |                     |                        |                         |
|---|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|---------------------|------------------------|-------------------------|
|   |                       | 0                    | 0,5 min              | 1 min                | 1,5 min              | 2 min                | 2,5 min             | 3 min                | 3,5 min              | 4 min                | 4,5 min              | 5 min               | J/c m2                 |                         |
| <b>Lamp</b>   | <b>400-518</b>        | 23.5<br>3            | 23.6<br>5            | 23.6<br>9            | 23.7<br>2            | 23.7<br>7            | 23.7<br>7           | 23.8<br>3            | 23.8<br>7            | 23.9<br>2            | 23.9<br>6            | 23.9<br>9           | <b>7.1</b><br><b>3</b> | 96.<br>5%               |
| <b>Fluoresc.</b>  | <b>519-760</b>        | 0.98                 | 0.94                 | 0.89                 | 0.87                 | 0.85                 | 0.83                | 0.82                 | 0.82                 | 0.80                 | 0.79                 | 0.78                | <b>0.2</b><br><b>6</b> | 3.5<br>%                |
| <b>total</b>  | <b>400-760</b>        | <b>24.5<br/>0132</b> | <b>24.5<br/>8279</b> | <b>24.5<br/>8891</b> | <b>24.5<br/>9305</b> | <b>24.6<br/>2182</b> | <b>24.6<br/>087</b> | <b>24.6<br/>5408</b> | <b>24.6<br/>9701</b> | <b>24.7<br/>2073</b> | <b>24.7<br/>4822</b> | <b>24.7<br/>711</b> | <b>7.3</b><br><b>9</b> | 99.<br>9%               |
| <b>%fluoresc<br/>ence</b>   |                       | 4.0<br>%             | 3.8<br>%             | 3.6<br>%             | 3.5<br>%             | 3.4<br>%             | 3.4<br>%            | 3.3<br>%             | 3.3<br>%             | 3.2<br>%             | 3.2<br>%             | 3.1<br>%            | <b>0.0</b><br><b>3</b> | 3.5<br>%                |
| <b>purple</b>   | <b>(400)-<br/>450</b> | 15.7<br>772          | 15.6<br>065          | 15.4<br>681          | 15.3<br>450          | 15.1<br>697          | 15.0<br>644         | 15.0<br>060          | 14.9<br>231          | 14.8<br>477          | 14.7<br>970          | 14.7<br>369         | <b>4.5</b><br><b>6</b> | 61.<br>7%               |
| <b>Blue</b>   | <b>450-500</b>        | 7.74<br>80           | 8.04<br>11           | 8.22<br>65           | 8.37<br>71           | 8.60<br>30           | 8.71<br>02          | 8.82<br>88           | 8.95<br>00           | 9.07<br>29           | 9.16<br>44           | 9.25<br>49          | <b>2.5</b><br><b>7</b> | 34.<br>8%               |
| <b>Green</b>  | <b>500-570</b>        | 0.03<br>96           | 0.03<br>23           | 0.02<br>91           | 0.02<br>76           | 0.02<br>86           | 0.02<br>65          | 0.02<br>75           | 0.02<br>71           | 0.02<br>81           | 0.02<br>82           | 0.02<br>82          | <b>0.0</b><br><b>1</b> | 0.1<br>%                |
| <b>Yellow</b>   | <b>570-591</b>        | 0.26<br>61           | 0.25<br>86           | 0.24<br>95           | 0.24<br>56           | 0.23<br>94           | 0.23<br>38          | 0.23<br>27           | 0.23<br>35           | 0.22<br>82           | 0.22<br>60           | 0.22<br>40          | <b>0.0</b><br><b>7</b> | 1.0<br>%                |
| <b>Orange</b>   | <b>591-610</b>        | 0.34<br>25           | 0.33<br>69           | 0.32<br>25           | 0.31<br>56           | 0.30<br>47           | 0.30<br>08          | 0.29<br>60           | 0.29<br>44           | 0.28<br>66           | 0.28<br>29           | 0.27<br>97          | <b>0.0</b><br><b>9</b> | 1.3<br>%                |
| <b>Red</b>  | <b>610-760</b>        | 0.34<br>42           | 0.32<br>34           | 0.30<br>87           | 0.29<br>73           | 0.29<br>10           | 0.28<br>73          | 0.27<br>72           | 0.28<br>30           | 0.27<br>09           | 0.26<br>32           | 0.26<br>05          | <b>0.0</b><br><b>9</b> | 1.2<br>%                |
| <b>(400-<br/>total</b>  | <b>700)</b>           | <b>24.5<br/>2</b>    | <b>24.6<br/>0</b>    | <b>24.6<br/>0</b>    | <b>24.6<br/>1</b>    | <b>24.6<br/>4</b>    | <b>24.6<br/>2</b>   | <b>24.6<br/>7</b>    | <b>24.7<br/>1</b>    | <b>24.7<br/>3</b>    | <b>24.7<br/>6</b>    | <b>24.7<br/>8</b>   | <b>7.3</b><br><b>9</b> | <b>10<br/>0.0<br/>%</b> |

Table 49: Royal Carolina Media, Eosin:Fluorescein, 1 layer

| Royal Carolina Media, Eosin:Fluorescein, 1 layer |                | mW/cm2 at 5 cm      |                     |                     |                     |                    |                     |                   |                   |                  |                   |                   |                         |                   |             |
|--|----------------|---------------------|---------------------|---------------------|---------------------|--------------------|---------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------------|-------------------|-------------|
|  |                | 0                   | 0,5 min             | 1 min               | 1,5 min             | 2 min              | 2,5 min             | 3 min             | 3,5 min           | 4 min            | 4,5 min           | 5 min             | J/c m2                  |                   |             |
| <b>Lamp</b>                                      | <b>400-518</b> | 45.1<br>8           | 44.9<br>2           | 44.8<br>7           | 44.8<br>2           | 44.<br>75          | 44.6<br>9           | 44.6<br>6         | 44.5<br>9         | 44.<br>59        | 44.5<br>7         | 44.5<br>4         | <b>13.</b><br><b>43</b> | 98.<br>4%         |             |
| <b>Fluoresc.</b>                                 | <b>519-760</b> | 0.78                | 0.79                | 0.78                | 0.75                | 0.7                | 0.72                | 0.70              | 0.68              | 0.6              | 0.66              | 0.65              | <b>0.2</b><br><b>2</b>  | 1.6<br>%          |             |
| <b>total</b>                                     | <b>400-760</b> | <b>45.9<br/>606</b> | <b>45.7<br/>075</b> | <b>45.6<br/>475</b> | <b>45.5<br/>746</b> | <b>45.<br/>478</b> | <b>45.4<br/>100</b> | <b>45.3<br/>9</b> | <b>45.2<br/>3</b> | <b>45.<br/>8</b> | <b>45.2<br/>6</b> | <b>45.2<br/>8</b> | <b>45.1<br/>900</b>     | <b>13.<br/>65</b> | 100.<br>.0% |

| %fluorescence |                  | 1.7 %         | 1.7 %         | 1.7 %         | 1.7 %         | 1.6 %         | 1.6 %         | 1.5 %         | 1.5 %         | 1.5 %         | 1.5 %         | 1.4 %         | 0.0 2          | 1.6 %           |
|---------------|------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|-----------------|
| <b>purple</b> | <b>(400)-450</b> | 27.0<br>635   | 26.5<br>869   | 26.4<br>423   | 26.2<br>921   | 26.<br>130    | 25.9<br>930   | 25.8<br>850   | 25.7<br>933   | 25.<br>702    | 25.6<br>407   | 25.5<br>755   | <b>7.8 5</b>   | 57.<br>5%       |
| <b>Blue</b>   | <b>450-500</b>   | 18.1<br>148   | 18.3<br>232   | 18.4<br>223   | 18.5<br>199   | 18.<br>610    | 18.6<br>862   | 18.7<br>644   | 18.7<br>845   | 18.<br>878    | 18.9<br>181   | 18.9<br>484   | <b>5.5 8</b>   | 40.<br>9%       |
| <b>Green</b>  | <b>500-570</b>   | 0.29<br>12    | 0.29<br>55    | 0.29<br>29    | 0.28<br>00    | 0.2<br>687    | 0.26<br>67    | 0.26<br>42    | 0.25<br>19    | 0.2<br>550    | 0.25<br>30    | 0.24<br>91    | <b>0.0 8</b>   | 0.6 %           |
| <b>Yellow</b> | <b>570-591</b>   | 0.29<br>04    | 0.29<br>76    | 0.29<br>12    | 0.28<br>58    | 0.2<br>791    | 0.27<br>45    | 0.26<br>99    | 0.25<br>93    | 0.2<br>589    | 0.25<br>26    | 0.24<br>81    | <b>0.0 8</b>   | 0.6 %           |
| <b>Orange</b> | <b>591-610</b>   | 0.15<br>84    | 0.16<br>09    | 0.15<br>72    | 0.15<br>55    | 0.1<br>516    | 0.15<br>08    | 0.14<br>45    | 0.14<br>26    | 0.1<br>381    | 0.13<br>55    | 0.13<br>27    | <b>0.0 4</b>   | 0.3 %           |
| <b>Red</b>    | <b>610-760</b>   | 0.04<br>70    | 0.04<br>85    | 0.04<br>66    | 0.04<br>61    | 0.0<br>425    | 0.04<br>36    | 0.04<br>04    | 0.04<br>21    | 0.0<br>382    | 0.04<br>04    | 0.04<br>03    | <b>0.0 1</b>   | 0.1 %           |
| <b>total</b>  | <b>(400-700)</b> | <b>45.9 7</b> | <b>45.7 1</b> | <b>45.6 5</b> | <b>45.5 8</b> | <b>45. 48</b> | <b>45.4 1</b> | <b>45.3 7</b> | <b>45.2 7</b> | <b>45. 27</b> | <b>45.2 4</b> | <b>45.1 9</b> | <b>13. .65</b> | <b>100 .0 %</b> |

#### EXAMPLE 10

5

##### *Fluorescence emission of re-dipped photoactivatable fibers*

A solution of Eosin Y in water was prepared at a concentration of 0.1g/L, and two polypropylene fibers were dipped in the solution to dope them with chromophore. They were then examined for their fluorescence as seen on DAY 1 to determine how well they retain their fluorescence over time as well as if dipped in water how much chromophore is retained. From this experiment, it can be seen that the tips of the fibers retain fluorescence after 3 days.

Figures 8A and 8B show the fluorescence emission under blue lamp after one day wherein the fibers were not emerged in water. Figures 8C and 8D show the fluorescence emission under blue lamp after three days wherein the fibers were not emerged in water. Figures 8E and 8F show the fluorescence emission under blue lamp after three days emerged in water.

#### EXAMPLE 11

20

##### *Qualitative Analysis of Dental Fiber Doping*

Commercially available dental fibers were dipped into solutions of Eosin Y (300 g/L, 200 g/L, 100 g/L, 50 g/L, 10 g/L, 1 g/L, or 0.1 g/L) for 10 seconds. The fibers were taken out and observed for color, then put under a blue lamp and the fluorescence was observed qualitatively. The 300-100 g/L Eosin Y solutions showed little fluorescence, while the 50

g/L Eosin Y solution showed fluorescence. A significant increase in fluorescence was observed when the 10 g/L Eosin Y solution was used.

Dental fibers were dipped into solutions of fluorescein (50g/L, 10g/L, 1g/L, 0.1g/L) for 10 seconds. The fibers were then taken out and observed for color, then put under a blue lamp and the fluorescence was observed qualitatively. The 50g/L fluorescein solution showed fluorescence.

Dental fibers were dipped into solutions of fluorescein: Eosin Y 1:1 (50g/L, 10g/L, 1g/L, 0.1g/L total chromophore) solution for 10 seconds again. The fibers were then taken out and observed for color, then put under a blue lamp and the fluorescence was observed qualitatively. The 50g/L fluorescein: Eosin Y 1:1 solution showed little fluorescence. A significant increase in fluorescence was observed when the 10g/L fluorescein: Eosin Y 1:1 solution was used.

Figures 9A-9P illustrate pictures of the fluorescence emission under blue lamp of fibers dipped in a solution of photoactivatable agents, i.e., commercial dental fibers in Eosin Y 50g/L (Figures 9A-9B); commercial dental fibers in Eosin Y 0.1 g/L (Figures 9C-9D); commercial dental fibers in fluorescein 50g/L (Figures 9E-19F), commercial dental fibers in fluorescein 0.1g/L (Figures 9G-9H), commercial dental fibers in fluorescein:Eosin Y 50g/L (Figure 9I-9J), commercial dental fibers in fluorescein:Eosin Y 0.1g/L (Figures 9K-9L), polypropylene fibers in fluorescein 50g/L (Figures 9M-9N), polypropylene fibers in fluorescein 0.1g/L (Figures 9O-9P).

Polypropylene fibers were dipped in solutions of fluorescein (50g/L, 10g/L, 1g/L, 0.1g/L total chromophore) for 10 seconds, then taken out and observed for color, then put under a blue lamp and the fluorescence was observed qualitatively. The 50g/L fluorescein solution showed little fluorescence. An increase in fluorescence was observed when the 10g/L fluorescein solution was used.

*EXAMPLE 12*  
*Preparation of photoactivatable fabric*

The polypropylene fiber used in the preparation of the photoactivatable fabric was acquired from Midwest Filtration (West Chester Township, OH, U.S.). The fabric tested was composed of polypropylene at densities ranging from 0.45 oz/yd<sup>2</sup> to 2.50 oz/yd<sup>2</sup>. It was  
5 observed that the polypropylene fabric at a density of 2.00 oz/yd<sup>2</sup> absorbs a significant amount of chromophore, while blocking less light than higher thicknesses (data not shown). A piece of the fabric was dipped in a small chromophore bath without Lurol oil PP-3771 while another piece of the fabric was dipped in a small chromophore bath comprising Lurol oil PP-3771. The dipped fabrics were then roll dried and heated in an oven. The process for  
10 the preparation of photoactivatable fabric is illustrated in Figure 10.

*EXAMPLE 13*  
*Preparation of a photoactivatable article of manufacture*

15 An article of manufacture comprising a photoactivatable fabric is envisioned. In particular, the article of manufacture is a suit made of a fabric comprising fibers (Figure 11A). In some instances, the fibers entering the composition of the fabric may be made of a virgin polymer, that is to say a polymer that does not comprise photoactivatable agent. In some other instances, the fibers entering into the composition of the fabric may be made of photoactivatable fibers which comprise photoactivatable agents. In the instances where the  
20 fabric comprises fibers made of virgin polymer, the fabric or the article of manufacture made with such fabric may be coated, dipped or sprayed with a photoactivatable agent composition so as to deposit photoactivatable agents onto the fabric and into the interstices created between the fibers of the fabric. A composition of lubricant may also be laid onto the fabric so as to facilitate the insertion of the photoactivatable agents into the interstices  
25 created between the fibers of the fabric. In this particular example the article of manufacture is a suit which is to be worn by a subject in need of phototherapy (Figure 11A). The photoactivatable fibers that are preferred for entering into the fabrication of the suit comprise nylon and polyethylene which comprise one or more photoactivatable agent. The  
30 resulting article of manufacture (e.g., a suit-like garment) is then photoactivated under light while being worn by the subject in need of phototherapy.

A suit-like garment was prepared by associating two photoactivatable fabrics having the following composition:

- (1) Photoactivatable fabric #1 was made from polypropylene fibers. The resulting fabric was dipped in the composition of 0.50 g/L Eosin Y + Luroil oil.
- 5 (2) Photoactivatable fabric #2 was made from polypropylene fibers. The resulting fabric was dipped in the composition of 0.25 g/L Eosin Y + 0.25 g/L Fluorescein + Luroil oil.

The juxtaposed photoactivatable fabrics were tailored into the suit-like garment illustrated in Figure 11B. The two fabrics may be joined, stitched, glued, attached, fused, sewed, or 10 bonded or the like, and thereafter tailored accordingly.

*EXAMPLE 14*  
*Cytokine and growth factor modulations using photoactivatable fabrics*

15 The purpose of this experiment was to assess the effect of the photoactivatable fibers of the present disclosure on secretion of cytokines and growth factors. To this end, a blue lamp (129.53mW/cm<sup>2</sup>) was placed either on top or on the bottom of human dermal fibroblasts (passage #3 (70,000 cells/ well) sample stage at 5 cm. Photoactivatable fabrics as identified in Table 50 below were wrapped around the custom made plastic frame (1-3 turn). Slides 20 were filled with ~1-1.4 ml of PBS and were placed on the stage directly over the fibers. Illumination carried out from bottom to top. Cells were illuminated for 13-15J/cm<sup>2</sup> for most of the fibers and media or for 5 J/cm<sup>2</sup>. Cells were then incubated for 24 hours in normal media/IFNg and the supernatant was collected and stored at -80°C. Antibody array assay 25 carried out on the collected supernatant and the expression level of cytokines and growth factors were analyzed and normalizing to IFNg stimulated cells. The results presented in Table 51 are based on at least 50% difference in the expression level compared to non-treated control only.

Table 50: Composition of photoactivatable fibers/fabrics

| <b>Photoactivatable Fiber/Fabric</b> | <b>Composition</b>  |
|--------------------------------------|---|
| 36                                   | Fabric 1 – polypropylene fibers (blank – no photoactivatable agent) |

|    |  |
|----|--|
| 37 | Fabric 2: polypropylene fibers + Eosin Y                 |
| 38 | Fabric 3: polypropylene fibers + Eosin y and fluorescein |
| 39 | Fabric 1+1 (2 layers)                                    |
| 40 | Fabric 2+3 ( 2 layers)                                   |

Table 51: Biological effect of Photoactivatable fabrics

| Sample                                   | Fabric 1 (Blank)                                |       | Fabric 2 (E)                                   |                     | Fabric 3 (E/F)                                 |   | Fabric 2+3 (E+E/F)   |     |
|--|---|-------|--|---------------------|--|---|--|-----|
| Photonic evaluation                      | P=10.11, B=6.70, G=0.04, Y=0.00, O=0.00, R=0.00 |       | P=7.41, B=4.37, G=0.09, Y=0.16, O=0.11, R=0.05 |                     | P=6.69, B=4.25, G=0.13, Y=0.15, O=0.09, R=0.03 |   | P=5.30, B=2.86, G=0.14, Y=0.26, O=0.20, R=0.10                       |     |
| Dose                                     | 15 J/cm <sup>2</sup>                            |       | 15 J/cm <sup>2</sup>                           |                     | 15 J/cm <sup>2</sup>                           |   | 15 J/cm <sup>2</sup>   |     |
| Modulations                              | ↓   | ↑     | ↓  | ↑                   | ↓  | ↑   | ↓  | ↑   |
| Cytokines, Chemokines and Growth factors | -----   | ----- | -----  | IL-6, GM-CSF, MCP-2 | -----  | GM-SCF, IL-2, IL-13, GRO $\alpha$ , MCP-2, MCP-3, ANG | G-SCF, IL-309, IL-15, IL-7, MDC, TGF $\beta$ 1, GRO $\alpha$ , IGF-1 | ANG |

P= purple, B= blue, G= green, Y = yellow, O = orange, R = red

The results represented above are from at least two independent experiments for each media.

5 The results suggest that the illumination of media 2 (Eosin) and media 3 (Eosin/Fluorescein) combined (layered) may have positive impacts on down regulation of I-309, IL-15, IL-7, MDC, TGF $\beta$ 1, GRO $\alpha$  and IGF-1. These cytokines and chemokines are involved in conditions such as contact allergic dermatitis (I-309, IL-7), psoriasis (GRO $\alpha$ , IL-15, IGF-1), atopic dermatitis (MDC), and scarring (TGF $\beta$ 1). However, these pathologies are complex  
10 and usually modulation of more proteins would be preferable.

Variations and modifications will occur to those of skill in the art after reviewing this disclosure. The disclosed features may be implemented, in any combination and subcombinations (including multiple dependent combinations and subcombinations), with 15 one or more other features described herein. The various features described or illustrated above, including any components thereof, may be combined or integrated in other systems. Moreover, certain features may be omitted or not implemented. Examples of changes, substitutions, and alterations are ascertainable by one skilled in the art and could be made without departing from the scope of the information disclosed herein. All references cited  
20 herein are incorporated by reference in their entirety and made part of this application.

What is claimed is:

1. A photoactivatable fiber comprising:
  - at least one thermoplastic polymer, and
  - at least one xanthene dye;

wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and

wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.
2. The photoactivatable fiber as defined in claim 1, wherein the at least one xanthene dye is uniformly dispersed throughout the photoactivatable fiber.
3. The photoactivatable fiber as defined in claim 1, wherein the at least one xanthene dye is non-uniformly dispersed throughout the photoactivatable fiber.
4. The photoactivatable fiber as defined in claim 1, wherein a first portion of the at least one xanthene dye is compounded with the at least one thermoplastic polymer and a second portion of the at least one xanthene dye is layered on the surface of the photoactivatable fiber.
5. The photoactivatable fiber as defined in claim 5, wherein the photoactivatable fiber comprises at least one layer of the at least one xanthene dye on its surface.
6. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is one or more of acrylic, acrylonitrile butadiene styrene (ABS), polybenzimidazole (PBI), polycarbonate, polyether sulfone (PES), polyetherether ketone (PEEK), polyetherimide (PEI), polyethylene (PE), polyphenylene oxide (PPO), polyphenylene sulfide (PPS), polypropylene (PP), polystyrene, polyvinyl chloride (PVC), teflon, polybutylene, polyethylene terephthalate (PET), polybutylene terephthalate (PBT), nylon, polylactic acid (PLA), polymethyl methacrylate polyester, polyurethane, rayon, and poly(methyl methacrylate) (PMMA).

7. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is one or more of nylon, polyethylene (PE), polypropylene (PP), polylactic acid (PLA), polybutylene terephthalate (PBT), and poly(methyl methacrylate) (PMMA).
8. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is nylon, polyethylene, polypropylene or any mixture thereof.
9. The photoactivatable fiber as defined in any one of claims 1 to 8, wherein the at least one xanthene dye is selected from the group consisting of Eosin Y, Eosin B, Erythrosine, Fluorescein, Rose Bengal and any mixture thereof.
10. The photoactivatable fiber as defined in any one of claims 1 to 8, wherein the at least one xanthene dye is: i) Eosin Y; ii) Fluorescein; iii) Eosin Y and Fluorescein; or iv) Eosin Y and Fluorescein and Rose Bengal.
11. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is nylon and the at least one xanthene dye is Eosin Y.
12. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is nylon and the at least one xanthene dye is Eosin Y and Fluorescein.
13. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is polyethylene and the at least one xanthene dye is Eosin Y.
14. The photoactivatable fiber as defined in any one of claims 1 to 5, wherein the at least one thermoplastic polymer is polypropylene and the at least one photoactivatable agent is Eosin Y.
15. The photoactivatable fiber as defined in any one of claims 1 to 14, the photoactivatable fiber having a linear mass density of between 400 Deniers and 480 Deniers.
16. The photoactivatable fiber as defined in any one of claims 1 to 15, further comprising a lubricant.
17. A photoactivatable fabric comprising a plurality of photoactivatable fibers wherein the photoactivatable fibers comprise:

- i) at least one thermoplastic polymer, and
- ii) at least one xanthene dye,

wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and

wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.

18. An article of manufacture comprising a photoactivatable fabric, wherein the photoactivatable fabric comprises:

- a) a plurality of fibers composed of at least one thermoplastic polymer; and
- b) at least one xanthene dye,

wherein the at least one xanthene dye is compounded and extruded with the at least one thermoplastic polymer at a concentration of between about 0.5 and about 20% w/w in water; and

wherein the at least one xanthene dye absorbs and emits light between about 400 nm and about 800 nm.

19. Method for effecting phototherapy on a subject, the method comprising:

- applying a photoactivatable fiber as defined in any one of claims 1 to 17 onto the subject; and
- illuminating the photoactivatable fiber with light having a wavelength that overlaps with an absorption spectrum of the at least one xanthene dye.

20. Method for effecting phototherapy on a subject, the method comprising:

- applying an article of manufacture as defined in claim 18 onto the subject; and
- illuminating the article of manufacture with light having a wavelength that overlaps with an absorption spectrum of the at least one xanthene dye.

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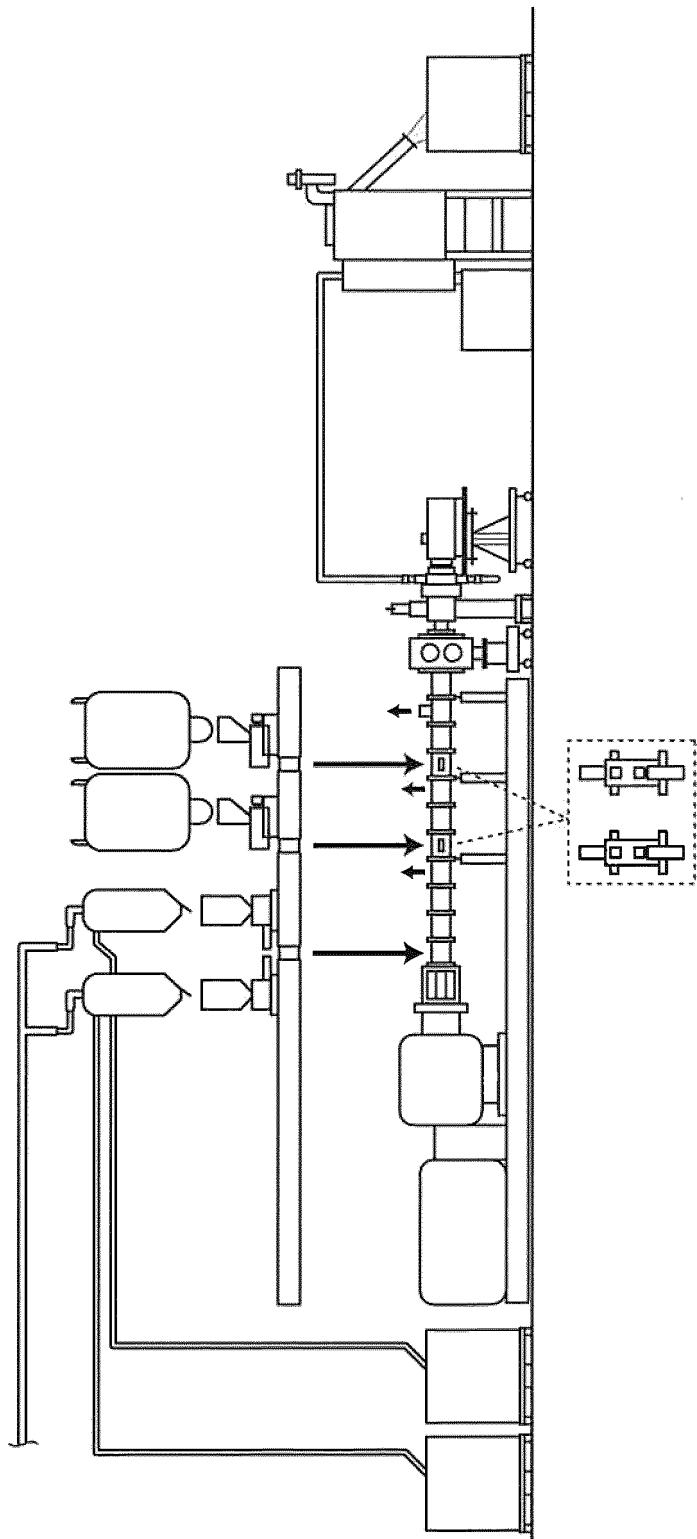
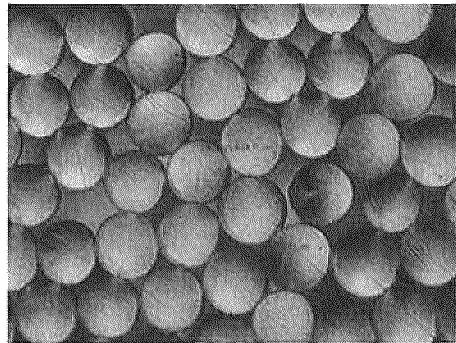


FIG. 1A

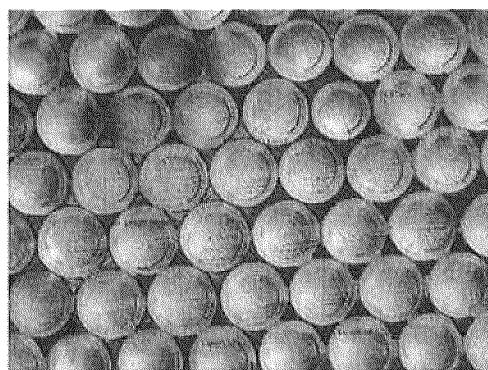
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**FIG. 1B**

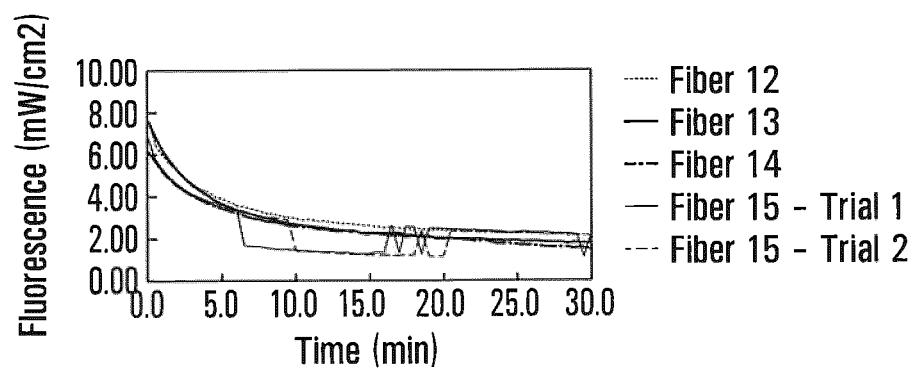
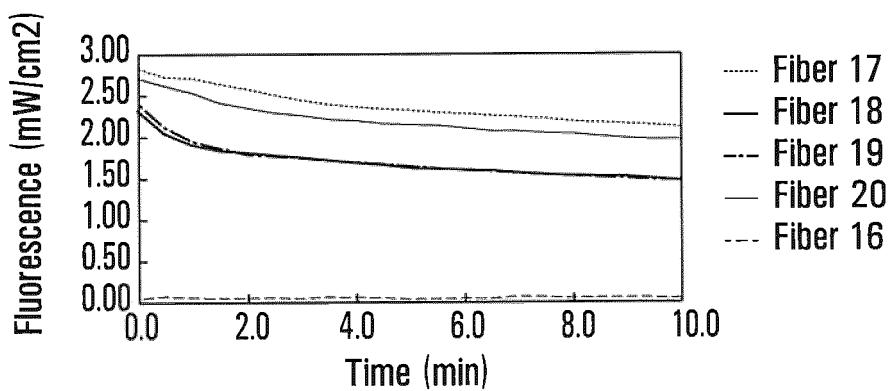


**FIG. 1C**

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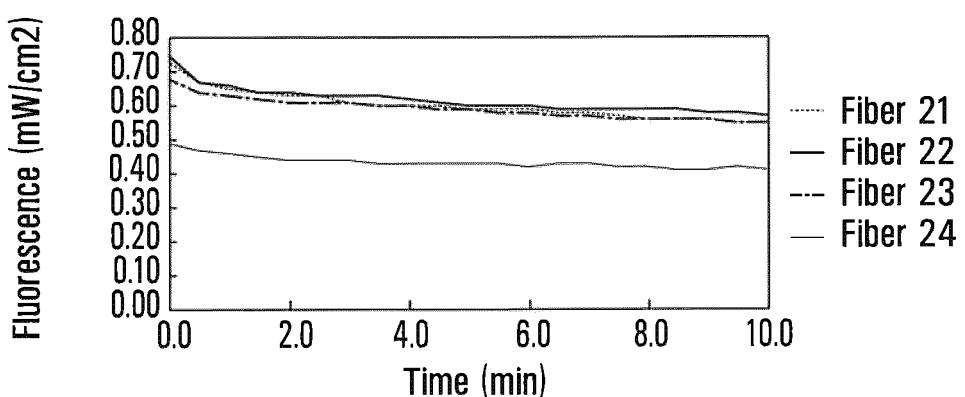
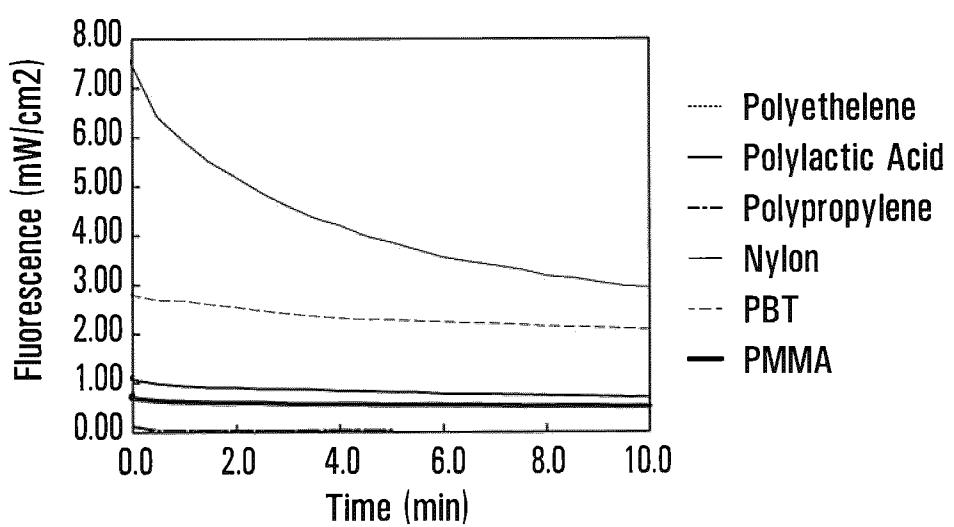
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**FIG. 2A****FIG. 2B**

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**FIG. 2C****FIG. 2D**

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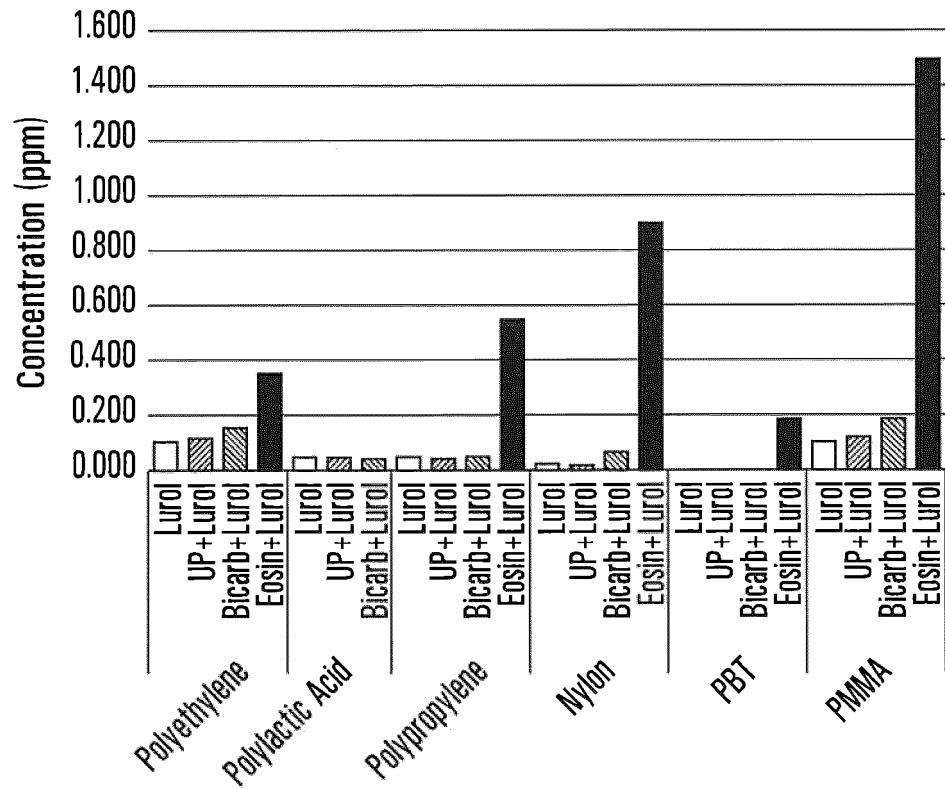


FIG. 3

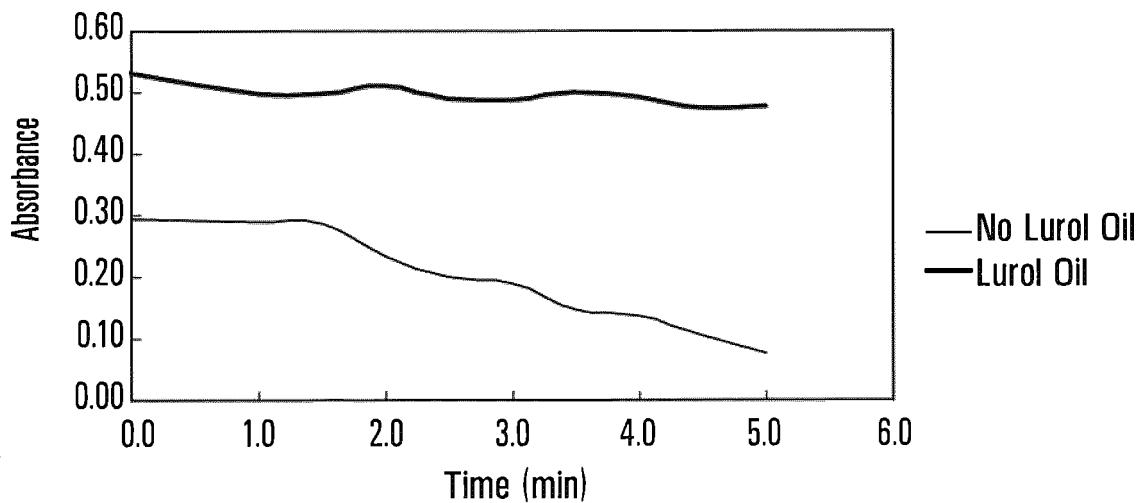
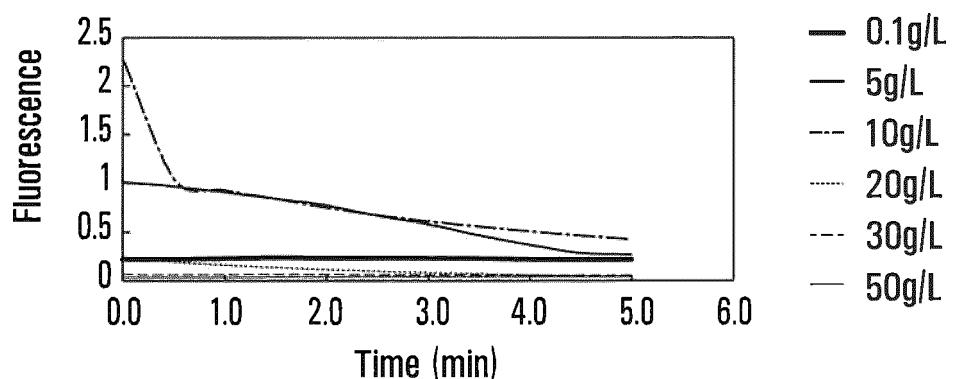
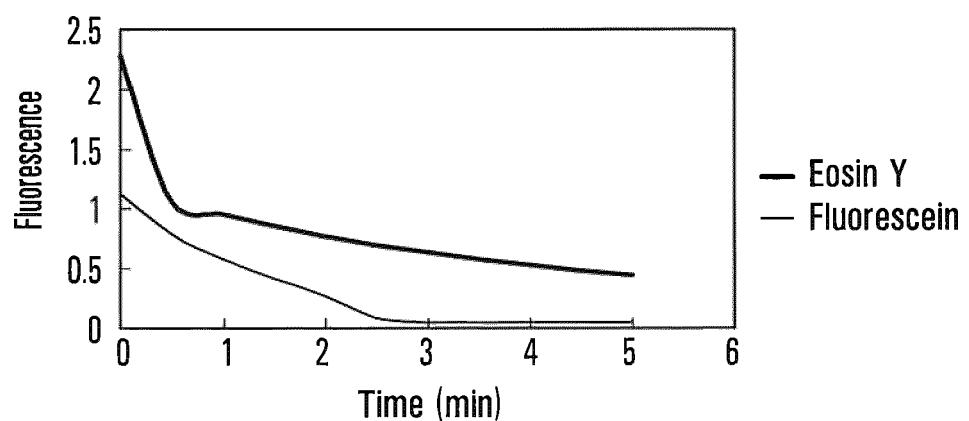


FIG. 4

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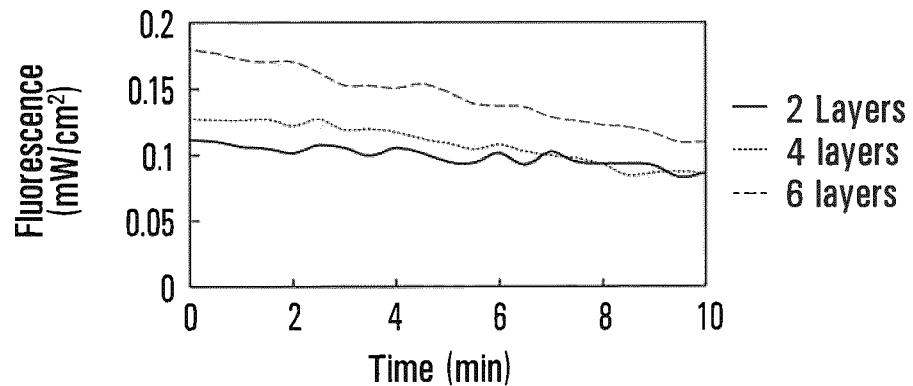
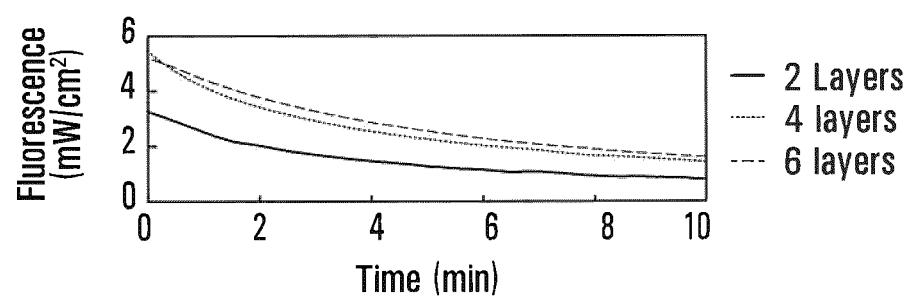
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**FIG. 5A****FIG. 5B**

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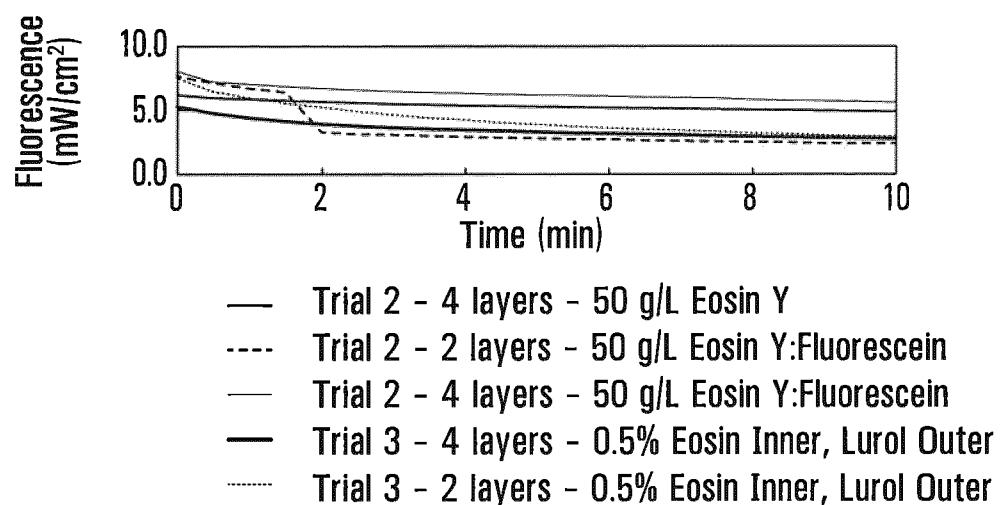
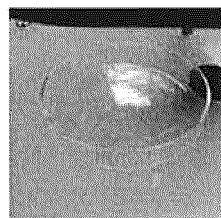
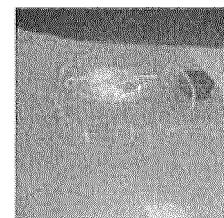
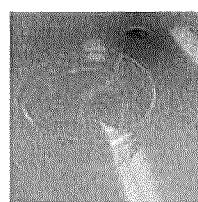
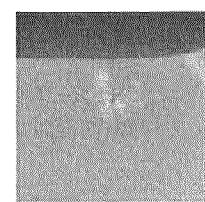
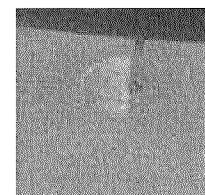
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**FIG. 6A****FIG. 6B**

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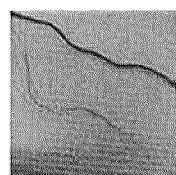
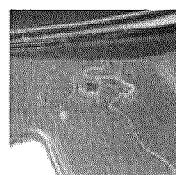
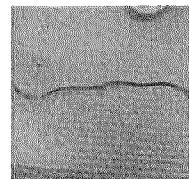
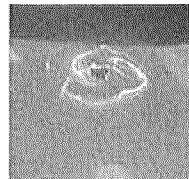
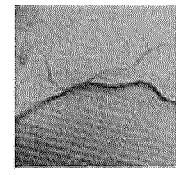
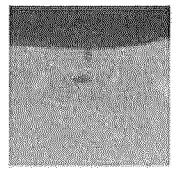
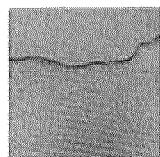
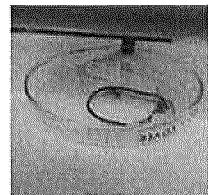
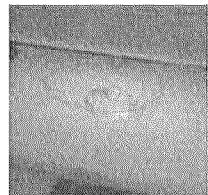
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**FIG. 7****FIG. 8A****FIG. 8B****FIG. 8C****FIG. 8D****FIG. 8E****FIG. 8F**

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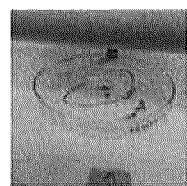
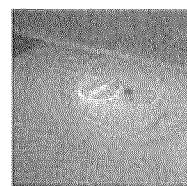
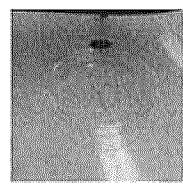
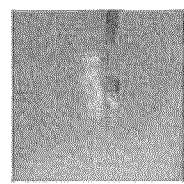
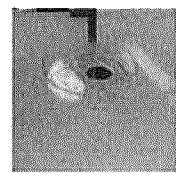
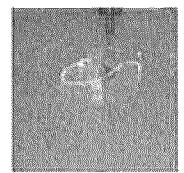
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**FIG. 9A****FIG. 9B****FIG. 9C****FIG. 9D****FIG. 9E****FIG. 9F****FIG. 9G****FIG. 9H****FIG. 9I****FIG. 9J**

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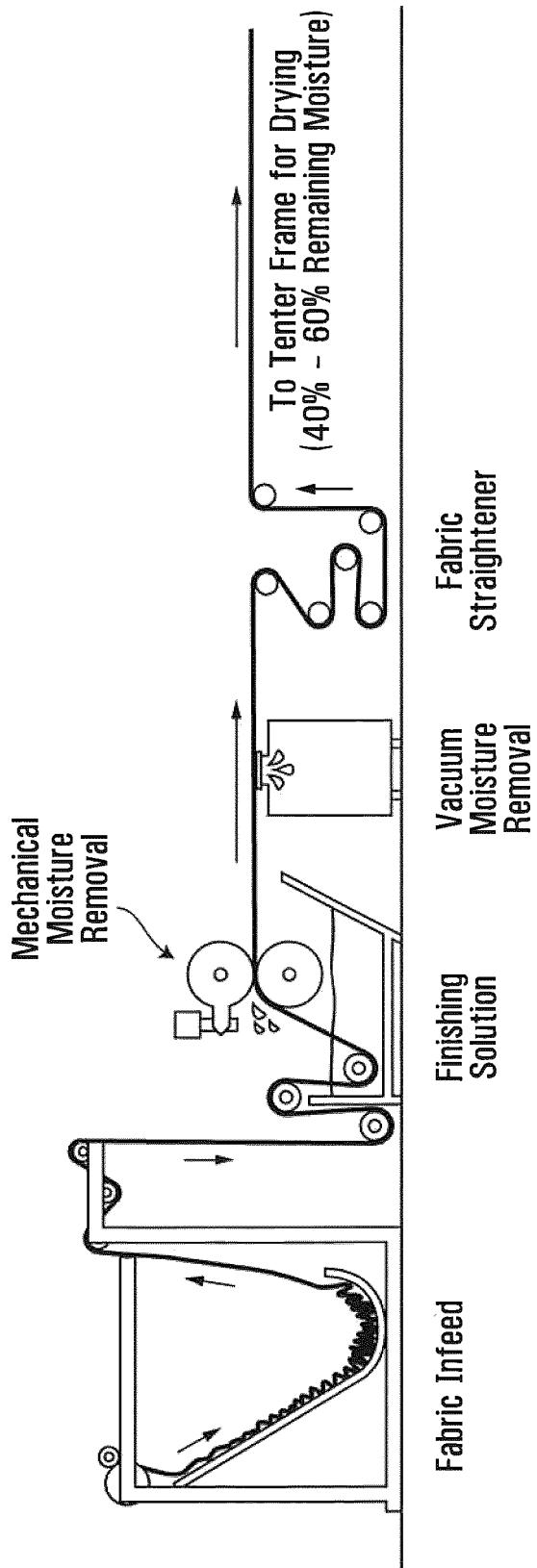
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**FIG. 9K****FIG. 9L****FIG. 9M****FIG. 9N****FIG. 9O****FIG. 9P**

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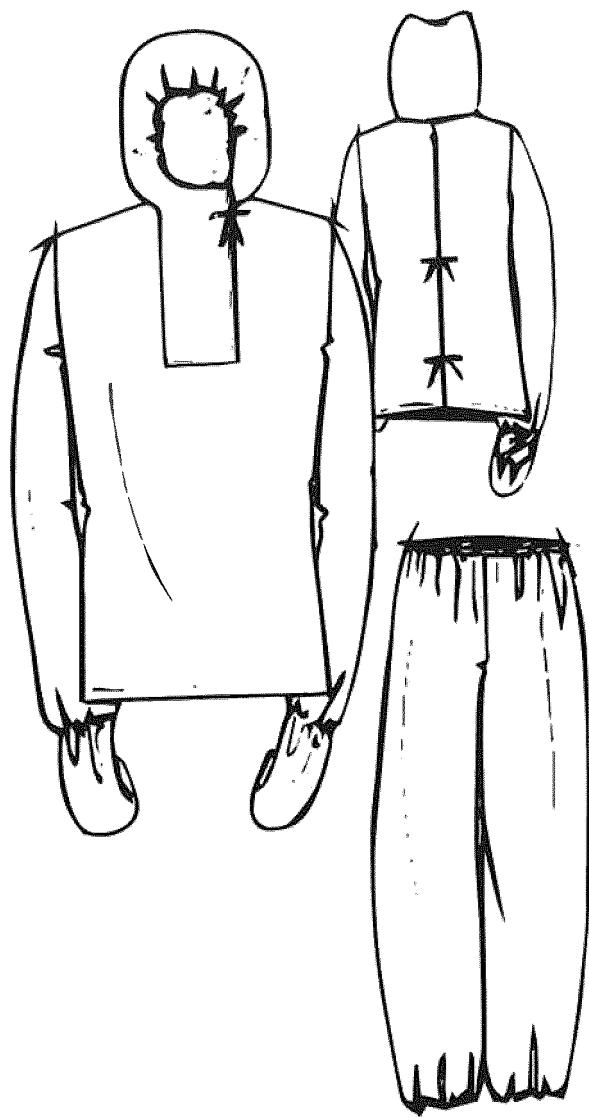
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**FIG. 10**

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**FIG. 11A**

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**FIG. 11B**

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