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# HAIR PIECES CONTAINING FIBERS OF NYLON 6, BUTADIENE-STYRENE COPOLYMER AND POLYALKYL METHACRYLATE

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## ABSTRACT OF THE DISCLOSURE

Hair pieces, wigs and like products in which the predominant hair-simulating fiber is a blend of nylon-6 and a modified polyalkyl methacrylate, method of making fiber, and fiber.

This invention relates to wigs and hair pieces which can be dyed, set, bleached, redyed and reset and almost unlimited number of times.

The use of wigs and hair pieces has increased very substantially in recent times but has, to some extent, been limited by inability of the wigs or hair pieces to be restyled and/or redyed without deterioration of the hair piece. Thus it has been necessary to own a large number of hair pieces or wigs in order to provide the owner with a variety of styles and/or colors. Many attempts have been made to utilize synthetic fibers in place of human hair, but generally these lack the desirable qualities necessary for an esthetically satisfactory hair piece. Typically, such synthetic materials may have an excessively shiny appearance, an unsatisfactory hand, and most often cannot be stripped of color in a manner to permit redyeing and restyling.

It has now been found that nylon can be blended with certain polymeric materials which can be formed into fibers and drawn to provide a fibrous material closely resembling human hair with respect to hand and luster. Wigs or hair pieces made from these fibers can be dyed, set, stripped and redyed and reset innumerable times. This fibrous material is ideally suited for the production of wigs and other hair pieces.

More specifically the blends contemplated for the present invention comprise in excess of 70% by weight, but less than 90% by weight of nylon-6 (polycaprolactam) and less than 30% but more than 10% of a modified polyalkyl methacrylate having a glass transition temperature ($T_g$) in the range of about 50° C. to about 110° C., and preferably in the range of about 88° to 105° C. As used herein, the term "modified polyalkyl methacrylate" is intended to encompass any composition in which the predominant component is a polyalkyl methacrylate, or in which the predominant monomeric component of the polymer is an alkyl methacrylate but which additionally contains at least 15%, but less than 50%, by weight of a butadiene-styrene copolymer. Additionally, the polyalkyl methacrylate shall be selected such that the ratio of its melt viscosity to that of nylon-6 shall be equal to or greater than 1.

Butadiene-styrene copolymers are at best only slightly compatible with polyalkyl methacrylates, however there is described in U.S. Pat. 2,943,074, of Feuer, a solid thermoplastic interpolymer of 85 to 25 parts by weight of a member of the group consisting of methyl methacrylate and mixtures of at least 55% by weight methyl methacrylate with another compound having a single vinylidene group copolymerizable therewith, and 15 to 75 parts by weight of a copolymer of 90 to 50% by weight of butadiene and 10 to 50% by weight of styrene. This interpolymer can be used per se provided the amount of



butadiene-styrene copolymer is within the range prescribed above. This material is prepared by polymerizing the methacrylate components in intimate contact with a butadiene-styrene copolymer latex as described in detail in the aforementioned patent as well as in U.S. Pat. 2,857,360.

As was noted, the above compositions can be used directly. However, the method of preparing the above polymers renders them relatively compatible with alkyl methacrylate polymers generally, thus the above described materials can be blended with polyalkyl methacrylates in suitable proportions to meet the above requirements for a modified polyalkyl methacrylate and such compositions are also intended to be covered by that term.

Accordingly, a typical polymer useful in accordance with the present invention is one such as coemulsified polymer A described in column 4 of the aforementioned U.S. Pat. 2,943,074, comprising 71.25 parts by weight methyl methacrylate and 3.75 parts by weight of acrylonitrile coemulsion polymerized on 25 parts by weight of a 70/30 butadiene-styrene copolymer latex. In place of the acrylonitrile, however, it is preferred to incorporate ethyl acrylate. Similarly, coemulsified polymer B of the aforementioned patent, comprising 50 parts by weight methyl methacrylate and 50 parts by weight of the butadiene-styrene rubbery copolymer latex, may be used for the purposes of the present invention. The copolymer latex C described in the above mentioned patent comprises 75 parts by weight of the butadiene-styrene latex and only 25 parts of methyl methacrylate. This material contains too much of the butadiene-styrene latex for use directly in the present invention. It can, however, be suitably blended with other predominantly methyl methacrylate polymers to provide a mixture in which the final butadiene-styrene copolymer latex is within the 15–50% range required for use as a modified alkyl methacrylate in accordance with the present invention. It is believed evident that the other copolymers A and B can be similarly mixed to provide differing compositions with respect to the rubbery latex content.

The alkyl methacrylates which may be satisfactorily used for blending with the above described rubbery latex containing interpolymers are any of those in which the alkyl methacrylate is the predominant component but which may contain minor amounts, e.g., 10% or less of other compatible comonomers provided the glass transition temperature of the resulting material is in the range of about 50° C. to about 110° C., and can be blended in a manner to meet the other requirements specified earlier herein. Blends of predominantly polyalkyl methacrylate polymers in which the blend meets the requirements are also useful. Accordingly, for the purposes of the present invention, reference to the term modified polyalkyl methacrylate is intended to include not only those interpolymers of the afore-mentioned U.S. 2,943,074 but also blends of such interpolymers with any of the above described predominantly alkyl methacrylate polymers.

Fibers produced from the above compositions are drawn to the general denier of human hair, which averages on the order of 50 to 75 denier. The drawing is conducted at a draw ratio of greater than 2:1 but less than 4:1, and preferably in the range of from about 2.75:1 to about 3:1. The fibres are drawn at a hot pin drawing temperature of at least 5° C. above the glass transition temperatures of the modified polyalkyl methacrylate additive, preferably at about 130° C. Higher temperatures can be used but do not contribute substantially to the overall processing.

The above described conditions are for the most part critical to the satisfactory attainment of the objectives

of the present invention. At a nylon content of about 70%, the fibers are found to be too weak and to have too low a fiber elongtaion for use in hair piece manufacture. However when the amount of nylon reaches about 90%, the filamentary material will not curl to the extent necessary to simulate the curling of human hair.

If the filamentary material is produced at lower draw ratios than those specified, the fiber will exhibit excessive cold drawing with its obvious concommitant undesirable characteristics. At higher draw ratios the fibers become too highly oriented; elongation and elasticity are lost and the fiber does not dye well. The draw pin temperature can of course be varied. However, lower pin temperatures tend to result in unevenly drawn fibers which dye unevenly.

In an example of the invention, a blend of 20% modified polymethyl methacrylate and 80% nylon-6 was prepared in an extruder by usual means, i.e., chips of the methacrylate and nylon were mixed in the appropriate proportions and fed to an extruder to produce a thoroughly blended extrudate. The nylon-6 had a reltaive viscosity (one part by weight nylon in 100 parts by volume of 97% sulfuric acid at 25° C.) of about 2.4. The modified methacrylate polymer consisted essentially of a physical mixture of the following polymers:

(a) 50% of an interpolymer of the type described in U.S. Pat. No. 2,943,074 prepared from 50 weight percent of a 71/29 butadiene-styrene copolymer latex, 45% methyl methacrylate, and 5% ethyl acrylate;
(b) 37.5% of a methyl methacrylate, 1% ethyl acrylate copolymer; and
(c) 12.5% of a methyl methacrylate, 14% ethyl acrylate copolymer.

The mixture had an overall butadiene-styrene copolymer content of 25% by weight with the balance essentially methyl methacrylate polymeric material. The nylon was melt extruded to form fibers of 150 denier. These fibers were hot drawn at a hot draw pin temperature of 130° C. to 50 denier. The hot-drawn fibers exhibit a tenacity of about 2.8 grams per denier and a residual elongation of 80–85%.

The above fibers can be tufted either individually or as a yarn bundle into any elastomeric power net to provide a hair piece which can be dyed, styled, stripped of dye, redyed, and restyled a multitude of times using essentially standard hair dyes and treatment conditions. The resulting hair pieces are found to approximate the more desirable characteristics of natural hair wigs but at a much-reduced cost. Most of the drawbacks found in hair pieces made from synthetic fibers are absent or minimized in these novel hair pieces.

Somewhat similar fibers can be prepared by blending predominantly alkyl methacrylate polymers (no butadiene-styrene copolymer) with nylon-6. Such fibers simulate human hair under most lighting conditions and useful hair pieces can be prepared therefrom. However, under diffuse light, such materials are somewhat duller than human hair and under direct sunlight the fibrous material loses essentially all appearance of human hair. The fibrous material of the present invention, however, duplicates the sheen and appearance of human hair under essentially all lighting conditions including direct sunlight.

It is possible to utilize higher viscosity nylon-6, viz, nylon having a relative viscosity of the order of 2.6–2.75 without adversely affecting the usefulness of the fibers for wig purposes. The chip may contain titanium dioxide or other dulling pigment but such is generally not required since the present materials are not generally as shiny as straight nylon-6 fibers.



In general, the fibers useful for the purpose of the present invention have a tenacity of at least 1.8 grams per denier and a fiber elongation of at least 80%.

What is claimed is:

1. In a hair piece, wig or the like, comprising a fiber-supporting substrate and hair-simulating fibers, the improvement which comprises, as the predominant hair-simulating fibers, hot drawn fibers of a blend of in excess of 70% but less than 90% by weight of nylon-6, and less than 30% but more than 10% of a composition comprising at least 50% up to 85% by weight of a polyalkyl methacrylate having a glass transition temperature in the range of about 50° C. to about 110° C. and at least 15% but less than 50% by weight of a butadiene-styrene copolymer having a butadiene-styrene ratio of 90:10 to 50:50, said blend characterized by a ratio of methacrylate polymer/nylon melt viscosities of at least 1, said predominant fibers characterized by a tenacity of at least 1.8 grams per denier and an elongation of at least 80%.

2. A hair piece, wig, or the like, in accordance with claim 1 wherein said methacrylate polymer is a polymer of methyl methacrylate containing not more than 5% ethyl acrylate.

3. A hair piece, wig or the like in accordance with claim 2 wherein said blend comprises about 20% by weight of the methacrylate polymer composition and about 80% by weight of nylon-6.

4. A method for producing a fiber useful in the manufacture of wigs, hair pieces, or the like which comprises preparing polymer blend of in excess of 70% but less than 90% by weight of nylon-6, and less than 30% but more than 10% by weight of a composition comprising at least 50% up to 85% by weight of a polyalkyl methacrylate having a glass transition temperature in the range of about 50° C. to about 110° C., and at least 15% but less than 50% by weight of a butadiene-styrene copolymer having a butadiene-styrene weight ratio of 90:10 to 50:50, said blend characterized by a ratio of methacrylate polymer/nylon melt viscosities of at least 1, forming a fiber from said blend, and hot drawing said fiber to hair denier at a draw pin temperature at least 5 degrees above the glass transition temperature of said methacrylate polymer, at a draw ratio greater than 2:1 but less than 4:1 to a fiber tenacity of at least 1.8 grams per denier and a fiber residual elongation of not less than 80%.

5. A method in accordance with claim 4 wherein said draw ratio is 2.75:1 to about 3:1.

6. A method in accordance with claim 5 wherein said draw pin temperature is about 130° C.

7. Fiber produced by the method of claim 4.

8. Fiber produced by the method of claim 5.

9. Fiber produced by the method of claim 6.


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