

622507

SPRUSON & FERGUSON

COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952

CONVENTION APPLICATION FOR A STANDARD PATENT

We Pfizer Hospital Products Group, Inc.

of 235 East 42nd Street, New York, NY, United States of America hereby apply
for the grant of a standard patent for an invention entitled:

Absorbable Coating and Blend

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION

Number of Basic Application:-

291,486

Name of Convention Country in which Basic Application was filed:-

United States of America

Date of Basic application:-

29 December, 1988

The address for service is:-

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DATED this SEVENTEENTH day of JANUARY 1990

Pfizer Hospital Products Group, Inc.

By:

J. G. Spruson
Registered Patent Attorney.

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA
SBR/JS/7029D



Absorbable Coating and Blend

~~X~~ I, ~~Allen~~ Allen J. Spiegel on behalf of Pfizer Hospital Products Group, Inc.

of 235 East 42nd Street, New York, State of New York,
United States of America

XX

1. I am/~~We~~ are authorised by

the applicant(s) for the patent to make this declaration on its/their behalf.

in U.S.A.

on December 29, 1988

by James R. Olson

~~XXXXXXXXXXXXXXmaximiser(s) of the function referred to
in the box or application(s)~~

(or where a person other than the inventor is the applicant)

3. James R. Olson

of 61 Greene Avenue, Norwich, State of Connecticut,
United States of America, Citizen: United States of
America, Occupation: Research Chemist.

(~~respectively:-~~)

is/are the actual inventor(s) of the invention and the facts upon which the applicant(s) is/are entitled to make the application are as follows:

Set out how Applicant(s) derive title from actual inventor(s) e.g. The Applicant(s) is/are the assignee(s) of the invention from the inventor(s)

The Applicant Company is the Assignee of the said invention from the actual inventors by virtue of an Assignment dated December 29, 1988

4. The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention (s) the subject of the application.

Declared at New York this 8 day of December 1989

New York

Pfizer. Hospital Products Group, Inc.

Signature of Declarant(s)

To: The Commissioner of Patents

1/81

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DIRECTOR OF FOREIGN PATENTS

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- (56) Prior Art Documents
US 4624256
US 4201216
US 4027676
- (57) Claim

1. An in vivo absorbable coating, suitable for a surgical article, comprising a blend of (1) a homopolymer of ϵ -caprolactone and (2) a crystallization modifier selected from the group consisting of crystalline fatty acids and crystalline esters of fatty acids.

2. The coating according to claim 1 wherein said crystalline esters of fatty acids are saturated C₁₂-C₁₈ fatty acid esters of polyhydric alcohols.

9. An in vivo absorbable controlled release matrix comprising a blend selected from the group consisting of (1) a homopolymer of ϵ -caprolactone and a crystallization modifier, as herein defined, and (2) a copolymer of at least about 80% by weight of ϵ -caprolactone and corresponding remainder weight of another absorbable monomer and a crystallization modifier.

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FORM 10

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COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

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Complete Specification Lodged:
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Name and Address
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Complete Specification for the invention entitled:

Absorbable Coating and Blend

The following statement is a full description of this invention, including the best method of performing it known to me/us

PC 7536

ABSORBABLE COATING AND BLEND

Abstract

Absorbable coating and absorbable blend of polycaprolactone and crystallization modifier
5 especially suitable for use in the coating of surgical sutures and in the controlled release of chemical or pharmaceutical agents.

PC 7536

ABSORBABLE COATING AND BLEND

The present invention pertains generally to absorbable coatings and absorbable blends for surgical sutures and drug delivery systems. More particularly, the invention relates to absorbable compositions which might include a homopolymer of ϵ -caprolactone and a crystallization modifier or a copolymer of ϵ -caprolactone, an absorbable monomer, and a crystallization modifier.

During the past thirty years, the use of synthetic absorbable polymers in medical devices and drug delivery systems has made a dramatic rise. Foremost in the area of absorbable medical devices has been the usage of absorbable polyesters that are usually aliphatic and linear. For example, in the area of wound closure, there has been extensive application of the homopolymer poly(glycolic acid), see for example U.S. Patent No. 3,297,033, and copolymers of glycolic acid with a variety of other monomers which produce likewise absorbable polymers, see for example U.S. Patent No. 3,839,297.

Dependent upon the specific application, there is a preferred time window where the synthetic polymer has completely absorbed, that is, has lost all of its mass to the surrounding tissue. In the case of absorbable sutures in sewn tissue after surgery, that window is usually within one year, although even shorter times are more preferable (U.S. Patents 4,027,676 and 4,201,216). For other applications this time window could be either shorter or longer. Thus, for a given

application there is a need to use absorbable polymers that degrade within the time limits of that application.

There is some leeway in the selection of synthetic absorbable polyesters for a given application since the rates of the hydrolysis of this class of polymers do vary over a wide range. Differences in the rates of hydrolysis of absorbable synthetic polyesters can be attributed to the intrinsic hydrolytic stability of their specific ester linkages and to the physical properties of their respective polymers. For instance, the hydrolytic stability of the ester linkage is strongly influenced by both electronic and steric factors. An example of an electronic effect is the increased reactivity of ester linkages which have a hydroxy substitution α to the ester linkage, as in the case of esters of glycolic acid. Physical properties which are important to the hydrolytic behavior and subsequent mass loss in synthetic absorbable polyesters include the glass transition temperature and the degree of crystallization in the polymer. In semi-crystalline polymers like poly(glycolic acid) and polycaprolactone, it has been hypothesized that hydrolysis takes place initially in the amorphous areas of the polymer, where migration or absorption of the water molecule is facile compared to the crystalline areas. Thus it appears that the water molecule prior to reaction at an ester linkage of a synthetic absorbable polyester must first have access or absorption into the polymer. Crystalline areas of the polymer have been hypothesized to impede the access or penetration of water molecules. Therefore, to the extent that this takes place, the overall hydrolytic breakdown of the absorbable polyester is retarded. In the case of polycaprolactone, the hydrolytic degradation rate and subsequent

mass loss is also dependent upon particle size, wherein small particles degrade and lose mass much more rapidly than a polymer cast in film form.

One application of synthetic polyesters is in the coating of surgical sutures. The coating on a surgical suture is very important in providing good knotting performance, as explained in U.S. Patent No. 3,390,681, where the snug down performance of a braided non-absorbable poly(ethylene terephthalate) suture under both dry and wet conditions was improved by deposition of small particles of non-absorbable polytetrafluoroethylene. Tie-down performance of braided polyethylene terephthalate has also been disclosed to be improved through its coating with linear polyesters (U.S. Patent No. 3,942,532) such as polycaprolactone. It was further disclosed in U.S. 3,942,532 that polycaprolactone of molecular weight in the range of 1,000 to 15,000 may also be used to coat synthetic absorbable sutures. However, polycaprolactone is known to be a slowly absorbable synthetic polyester, that may not meet the absorption time window, as it is known in the art, for an absorbable suture. Indeed, in subsequent U.S. Patent Nos. 4,027,676 and 4,201,216 it is pointed out that the disclosure of linear polyesters for use with absorbable sutures in U.S. Patent No. 3,942,532 did not consider that the sutures would not be totally absorbable. On the other hand, high molecular weight polycaprolactone has been disclosed in U.S. Patent No. 4,624,256 to provide improved tie down performance and knot security to braided multifilament poly(glycolic acid) sutures under both dry and wet conditions. Thus, the art clearly demonstrates the usefulness of polycaprolactone as a coating for sutures in terms of tie-down performance and knot security. However, the use of an absorbable polymer must be matched with its

allowable time window for complete absorption for a given application. Thus there is a need to be able to regulate the in vivo absorption profile of absorbable polymers to meet the criteria of specific applications.

5 An object of the invention is to increase the in vivo absorption rate of polycaprolactone by blending it with crystallization modifiers that reduce the amount of crystallinity in the polymer. Thus its rate of hydrolysis and subsequent mass loss can be regulated in order to meet the needs of a specific application. A further object of the invention is to
10 provide an absorbable coating for absorbable sutures which meets the time window of complete absorption within one year of surgery and provides good tie-down performance under both dry and wet conditions. An additional object of the invention is to provide a controlled absorbable matrix for the controlled release of chemical or pharmaceutical agents.

15 The present invention is directed toward an in vivo absorbable coating, suitable for a surgical article, comprising a blend of (1) a homopolymer of ϵ -caprolactone and (2) a crystallization modifier selected from the group consisting of crystalline fatty acids and crystalline esters of fatty acids.

20 The surgical article is preferably a suture, more preferably an absorbable suture.

 Throughout the specification and claims the crystallization modifier is taken to be either a crystalline fatty acid or a crystalline ester of a fatty acid. Preferably, the crystallization modifier is a
25 crystalline ester of a fatty acid. Particularly suitable crystallization modifiers are crystalline esters of fatty acids which are saturated C_{12} - C_{18} fatty acid esters of polyhydric alcohols. Preferably, the polyhydric alcohols might be glycerol, ethylene glycol or propylene glycol.

30 The coating composition includes a range from about 95 to about 5% by weight of the homopolymer of ϵ -caprolactone and a range of from about 5 to about 95% by weight of the crystallization modifier. In one composition, the homopolymer of ϵ -caprolactone ranges from about 70 to about 30% by weight and the crystallization modifier ranges in weight
35 from about 30 to about 70%. In a specific composition, the homopolymer of ϵ -caprolactone and the crystallization modifier are each about 50%

by weight. The homopolymer of ϵ -caprolactone has a molecular weight of at least about 1,000 and a molecular weight range of preferably from about 15,000 to about 40,000.

Also included within the scope of the invention is an absorbable
5 blend comprising a homopolymer of ϵ -caprolactone and a crystallization modifier. The present invention further includes an absorbable surgical suture comprising at least one filament coated with an absorbable coating of the invention. Preferably, the filament comprises poly(glycolic)
10 acid. The suture further comprises a copolymer having at least about 85% glycolic acid units.

The invention further embodies an absorbable controlled release matrix comprising a blend of a homopolymer of ϵ -caprolactone and a crystallization modifier.

The invention is also directed to an in vivo absorbable controlled
15 release matrix comprising a blend selected from the group consisting of (1) a homopolymer of ϵ -caprolactone and a crystallization modifier, as herein defined, and (2) a copolymer of at least about 80% by weight of ϵ -caprolactone and corresponding remainder weight of another absorbable monomer and a crystallization modifier.

20 The matrix further includes either a chemical or a pharmaceutical agent. The matrix crystallization modifier might either be a crystalline fatty acid or a crystalline ester of a fatty acid, preferably the latter. Suitable crystallization modifiers are crystalline esters of fatty acids which are saturated C_{12} - C_{18} fatty acid esters of
25 polyhydric alcohols, preferably such as glycerol, ethylene glycol or propylene glycol. The matrix homopolymer of ϵ -caprolactone ranges in weight from about 95 to about 5% by weight of the blend and the crystallization modifier ranges in weight from about 5 to about 95% by

weight of the blend.

In a further embodiment, the invention includes an absorbable blend comprising a copolymer of at least about 80% by weight of ϵ -caprolactone and corresponding remainder weight of another absorbable monomer, and a crystallization modifier. The blend further includes either a chemical or pharmaceutical agent.

The invention further embodies a method for effecting the rate of absorption of polycaprolactone comprising the step of blending a homopolymer of ϵ -caprolactone and a crystallization modifier. The absorption rate increases as the blend ratio of the crystallization modifier to the homopolymer of ϵ -caprolactone increases.

The in vivo absorption rate of polycaprolactone can be increased by blending the polymer with crystalline fatty acid esters of polyhydric alcohols, which function as crystallization modifiers. Furthermore, the rate of this absorption can be regulated by control of the amount of added crystalline modifier. The blending of these fatty acid esters with the polycaprolactone do not however adversely effect its excellent coating properties. Thus the polycaprolactone-fatty acid ester blends of the present invention are an excellent absorbable coating for absorbable sutures such as those of braided poly-(glycolic acid). Moreover, these blends can be used in the controlled release of chemical or pharmaceutical agents.

The rate of hydrolysis and subsequent mass loss in the hydrolytic degradation of polycaprolactone has been increased through the blending of the polycaprolactone with a crystallization modifier. In essence, the crystallization modifiers have been found to reduce the

amount of crystallization in the polycaprolactone and to also retard the film forming ability of polycaprolactone that has been cast from solution in a volatile solvent. Remarkably, the blending of the polycaprolactone with the crystallization modifiers of the present invention does not adversely affect the desired properties of the polycaprolactone. The crystallization modifiers of the present invention are themselves crystalline in nature and readily form homogeneous solid blends with polycaprolactone either by casting from a solution of each or by preparation from a melt. This suggests an intimate interaction and compatibility between the polycaprolactone and the non-polymer crystallization modifiers.

In this invention, both homopolymers and copolymers of ϵ -caprolactone are suitable for blending with a crystallization modifier. Homopolymers of ϵ -caprolactone should have a minimum molecular weight of at least about 1000. However, there is no maximum limit that is applicable to the homopolymer. A variety of molecular weights in polycaprolactones is commercially available from Union Carbide Corporation under the Tone brand name. For example, lower molecular weight polycaprolactones are available as Tone Polyols, while higher molecular weight polycaprolactones are available as Tone FCL-300 and Tone PCL-700, which have weight average molecular weights of 15,000 and 40,000, respectively, as reported by the manufacturer. Copolymers of ϵ -caprolactone are those synthesized from at least about 80% by weight of the ϵ -caprolactone monomer and the corresponding remainder of another absorbable monomer. The copolymers could be either random or block copolymers. Absorbable monomers consistent with these copolymers include glycolic acid, lactic acid, and other aliphatic

hydroxycarboxylic acids which are usually polymerized from their corresponding lactones, that is, glycolide, lactide, etc. Such copolymers, which contain a high percentage by weight of polycaprolactone segments, can have their in vivo absorption rates increased by their blending with crystallization modifiers.

In this invention, crystallization modifiers have been found which affect the crystallinity of polycaprolactone and its film forming ability. The preferred crystallization modifiers have been found to be saturated C_{12} - C_{18} fatty acid esters of polyhydric alcohols. Polyhydric alcohols useful in this invention are, for example, glycerol, ethylene glycol and propylene glycol. Commercial sources of these materials, which are often a mixture of compounds like glycerol monostearate (also contains glycerol palmitate for instance), are suitable in this invention. Such esters are crystalline in nature, that is, show characteristic X-ray powder diffraction patterns of crystalline matter. It is believed that this inherent crystallinity of these fatty acid esters allows for a crystalline interaction with the "semi-crystalline" polycaprolactone, which produces a lower net crystallinity in the blend. Furthermore, that this disruption in crystallinity in the net blend and in the constituent polycaprolactone is responsible for the disruption in film forming ability in the polycaprolactone. Thus, two factors of critical importance in the rate of hydrolytic degradation and subsequent mass loss of polycaprolactone can be controlled by the addition of the crystallization modifiers of this invention. Another important characteristic of these crystallization modifiers is that they are water insoluble, but enzymatically degradable. Therefore, the crystallization modifiers will not be rapidly

leached out of their crystalline interaction with the polycaprolactone and can prevent the re-crystallization of the polycaprolactone as it is subject to hydrolytic degradation in its molecular weight.

5 X-ray powder diffraction spectra have been taken on polycaprolactone-700 (PCL-700) (Union Carbide), glycerol monostearate (GMS) pure (Stepan Chemical Co.), physical mixtures of the two components, and blends of
10 the two components. The physical mixture of the two components was prepared by mixing equal amounts of powdered PCL-700 and GMS together at room temperature. The blends were prepared for the diffraction
15 experiments by first dissolving the two solutes in a methylene chloride/methanol solvent to give about a 10% by weight solution. Next, the solvent was evaporated to leave the solid blend, which was carefully ground with a mortar and pestle to produce uniform powder. Diffraction patterns were recorded in the range of 20
20 values of 10° to 30° with a powder diffractometer using copper $K\alpha$ radiation. Maximum diffraction intensities were observed in this range for the polycaprolactone, the glycerol monostearate, the physical mixture, and the respective blends. The total area underneath each
25 diffraction pattern was quantified, then scaled to a relative area based upon the physical mixture having an area value of 100. The relative area for each sample is a measure of its total crystallinity. A comparison of the relative areas under the diffraction patterns in this range is given in Table 1.

TABLE I

	<u>COMPOSITION</u>	<u>RELATIVE AREA</u>	<u>% DECREASE IN TOTAL CRYSTALLINITY</u>
5	physical mixture 50% PCL + 50% GMS	100	--
	blend 50% PCL + 50% GMS	65	35%
	blend 33% PCL + 67% GMS	56	44%
10	blend 20% PCL + 80% GMS	45	55%

Comparison of the diffraction pattern of a 1 to 1 physical mixture of polycaprolactone(PCL) with glycerol monostearate(GMS) to the diffraction pattern of the 1 to 1 blend of the two components, which was prepared as described above, shows a 35% decrease in crystallinity in the blend. Larger decreases in crystallinity occur as the proportion of the glycerol monostearate is increased. Furthermore, it is evident that the crystallinity is decreased in both components. Thus, an intimate interaction between the two components is suggested.

A qualitative assessment of the relative film forming ability of polycaprolactone versus the blends of this invention was carried out by decantation of the respective 10% by weight solutions onto a flat surface and allowing the solvent to evaporate. In this experiment mono-di-glycerides (MDG) (Stepan Chemical Co.) was used as the crystallization modifier for polycaprolactone-700 (Union Carbide). These results are summarized in Table II and show a dramatic decrease in film forming ability as the proportion of the crystallization modifier is increased.

Table II

	<u>COMPOSITION</u>	<u>FILM DESCRIPTION</u>
	100% PCL	strong, tough, clear
	90% PCL + 10% MDG	very weak film, opaque
5	70% PCL + 30% MDG	forms white layer, weak cohesion
	50% PCL + 50% MDG	forms white solid, weak cohesion
	30% PCL + 70% MDG	forms white particulate solid
	10% PCL + 90% MDG	forms white particulate solid

10 The film forming tendencies of the blends of this invention were further investigated by following coated poly(glycolic) (PGA) suture integrity under in vitro conditions. For example, size 0 braided poly(glycolic acid) sutures uncoated, coated with 100% polycaprolactone-700 (Union Carbide), and coated with a 1 to 1 blend of polycaprolactone-700 (Union Carbide) and glyceryl monostearate pure (Stepan Chemical Co.) were each immersed in buffer solution at a pH of 7.0 in test tubes and placed in a constant temperature bath at 50°C. The coated sutures had coating weight pick-ups of 7 and 5% for the PCL-700 and the 1 to 1 blend, respectively. Visual inspection of the sutures was recorded over time. By Day-48 both the uncoated PGA suture and the suture coated with a blend of PCL/GMS had degraded to a lint-like residue. However, the PCL coated suture was only broken into small rigid segments. This appearance of the PCL coated suture was unchanged at Day-78 and suggested that the suture was encapsulated by a strong, tough film of the polycaprolactone. On the other hand, both the uncoated suture and the suture coated with a 1 to 1 blend of PCL/GMS exhibited a similar degree of degradation in the same time frame of 48 days.

Although the primary object of this invention is

to influence and regulate the rate of hydrolysis and mass loss in polycaprolactone, this objective should not be achieved at the expense of its application benefits. In the case of its application as an
5 absorbable suture coating it has been found that the coating effectiveness of the various blends is actually increased over that of 100% PCL. Thus it appears that the blending of polycaprolactone with the crystallization modifiers of this invention enhances the softness
10 and pliability of the suture as compared to a suture coated with only polycaprolactone.

The blends of polycaprolactone and crystallization modifiers of the present invention also have application in the controlled release of chemical and
15 pharmaceutical agents. Indeed, the proportion of crystallization modifier to polycaprolactone can be used to regulate the rate of release of chemical or pharmaceutical agents. Moreover, these blends have improved rates of mass loss when compared to matrices
20 of 100% PCL. The blending of polycaprolactone with a crystallization modifier like glycerol monostearate thus produces an absorbable matrix with many beneficial attributes. Besides the benefit of regulated release and mass loss, blends of this invention are expected to
25 in general release agents faster than that of 100% polycaprolactone, yet much slower than 100% of a crystallization modifier like glycerol monostearate.

The following illustrate, by way of example, use of an absorbable blend for an absorbable suture
30 (Example 1) and an absorbable controlled release matrix (Example 2).

Example 1

A coating solution comprised of the following by weight percent, 5.5% polycaprolactone-700 (Union
35 Carbide), 5.5% mono-di-glycerides (Stepan Chemical Co.),

9% methanol, and 80% methylene chloride, was used to coat absorbable braided sutures of poly(glycolic acid) in the size range from size 2 to 6/0. A continuous feed of the spooled uncoated suture was passed for a short time at a fixed rate through the coating solution, then allowed to air dry before winding onto a take-up spool. The coated sutures showed a dry weight coating pick-up in the range of about 2 to 5% depending upon size. The coated suture has excellent handling and tie-down properties under both dry and wet conditions for all sizes. Comparison of the implantation of this sterile coated suture versus that of the sterile uncoated suture in rats, has shown that the coating does not effect the in vivo tensile strength of the suture during the critical time period of wound healing. Additionally, over a longer time period, both the coated and uncoated sutures exhibited a similar rate of absorption. Comparison of the implantation of the sterile coated suture of this invention versus sterile poly(glycolic acid) sutures coated with only polycaprolactone 700 in rats, has shown that the coated sutures of this invention show complete absorption before those sutures coated with just polycaprolactone. Furthermore, the coated sutures of this invention show complete absorption of suture and coating, well within a time window of one year.

Example 2

Application of absorbable blends of polycaprolactone and a crystallization modifier as an absorbable controlled release matrix was demonstrated by following the in vitro release of methylene blue (Aldrich Chemical Co.) from thin disks of the absorbable matrix. Methylene blue is a water soluble dye and was used to mimic the release of a water soluble chemical or pharmaceutical agent from the absorbable matrix.

Absorbable controlled release matrices containing methylene blue were prepared as follows. Portions of solid polycaprolactone-700 (Union Carbide) and mono-di-glycerides (Stepan Chemical Co.) in relative proportions of 7 to 3, 1 to 1, and 3 to 7 were heated to about 90°C and stirred to give homogeneous melts. Exactly 0.4% by weight of methylene blue was then mixed into each melt. The melts were then poured onto a cool plate to form disks 2 mm thick. Immersion of equal amounts of disks of each composition in buffer solution of pH 7.0 at a temperature of 50°C showed a staggered rate of blue dye release as a function of disk composition. The rate of dye release increased with increasing amounts of mono-di-glycerides to polycaprolactone. Moreover, the rates of dye release from the absorbable matrices were greater than that of a similarly prepared disk of 100% PCL-700, but lower than that of similarly prepared disks of mono-di-glycerides.

The present invention has been described herein with specific reference to the preferred embodiments thereof. However, those skilled in the art will understand that changes may be made in the form of the invention covered by the claims without departing from the scope and spirit thereof, and that certain features of the invention may sometimes be used to an advantage without corresponding use of the other features.

The claims defining the invention are as follows:

1. An in vivo absorbable coating, suitable for a surgical article, comprising a blend of (1) a homopolymer of ϵ -caprolactone and (2) a crystallization modifier selected from the group consisting of crystalline fatty acids and crystalline esters of fatty acids.
2. The coating according to claim 1 wherein said crystalline esters of fatty acids are saturated C_{12} - C_{18} fatty acid esters of polyhydric alcohols.
3. The coating according to claim 1 or claim 2 wherein said polyhydric alcohols are selected from the group consisting of glycerol, ethylene glycol and propylene glycol.
4. The coating according to any one of claims 1 to 3 wherein said coating comprises a range of from about 95 to about 5% by weight of said homopolymer of ϵ -caprolactone and a range of from about 5 to about 95% by weight of said crystallization modifier.
5. The coating according to any one of claims 1 to 4 wherein said homopolymer of ϵ -caprolactone has a molecular weight of at least about 1,000.
6. An in vivo absorbable coating, suitable for a surgical article, which coating is substantially as herein described with reference to Example 1.
7. An absorbable surgical suture comprising at least one filament coated with the absorbable coating of any one of claims 1 to 6.
8. The suture according to claim 7 wherein said filament comprises poly(glycolic acid).
9. An in vivo absorbable controlled release matrix comprising a blend selected from the group consisting of (1) a homopolymer of ϵ -caprolactone and a crystallization modifier, as herein defined, and (2) a copolymer of at least about 80% by weight of ϵ -caprolactone and corresponding remainder weight of another absorbable monomer and a crystallization modifier.
10. The matrix according to claim 9 further including either a chemical or a pharmaceutical agent.

- 16 -

11. An in vivo absorbable controlled release matrix, substantially as herein described with reference to Example 2.

DATED this NINTH day of JANUARY 1992
Pfizer Hospital Products Group, Inc.

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

