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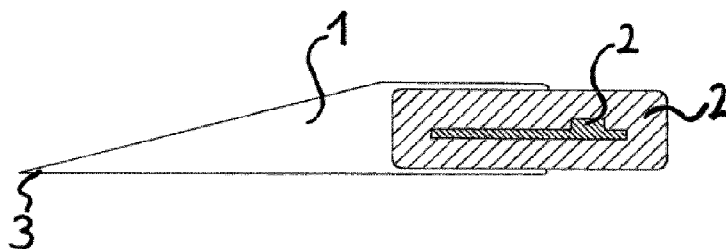
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(54) Title: INSERTION TOOL FOR ELECTRONIC DEVICE UNITS

Figure 1



(57) Abstract: The invention relates to an insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end and which polymer or copolymer composition undergoes softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes.

Insertion tool for electronic device units

Field of the invention

The invention refers to an Insertion tool comprising an insertion part to be implanted under the skin of an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an integrated electronic device unit, preferably a Radio Frequency Identification (RFID) chip unit.

Technical Background

US 2008/0042849 describes a bioimplant Radio Frequency Identification (RFID) tag to be implanted in a living body of an animal to conduct information management for the animal through wireless communication. A quite small bioimplant RFID tag capable of being hypodermically implanted in a small animal such as a mouse is disclosed. The bioimplant RFID tag having a diameter of 1 mm and a length of 7 mm includes a very small antenna having a length of 6 mm and a width of 1.5 mm and IC chip (μ chip®) having a shape of 0.5 mm by 0.5 mm rectangle. The tag is mounted on the antenna. The antenna is wound on a resin rod made of a flexible material. In this connection a slit is disposed in the antenna for impedance matching. Therefore the antenna is very small. A predetermined communication distance can be secured. For example the radio wave frequency is 2.45 Gigahertz (GHz) to be used for communication distance of several millimetres is securable. The input output impedance of the IC chip may be for instance 50 ohm. Several insertion tools are disclosed. For instance a syringe with a piston may be used to force the RFID tag directly under the skin. A curved needle with a suture, that carries the RFID tag at its end, may be used to drag the chip under the animal skin. A knot in the suture may be used to mark the insertion place and to prevent movement of the tag.

It is generally known to implant electronic device units like for instance RFID chip units under the skin of various small animals, pets, domestic animals or animals for production (farm animals like pigs, sheep, cattle or horses). The most common

insertion tool for implanting the electronic device unit under the skin of an animal is a syringe with a hollow plastic or steel needle. The syringe is provided with a piston to press the electronic device unit through the channel of hollow needle. After penetration of the animal skin with the tip of the needle, the electronic device unit is forced by the piston through the channel of the hollow needle under the animal skin.

Objects of the invention

The most common insertion tool for implanting an electronic device unit, for instance a RFID chip unit, under the skin of an animal is a syringe with a hollow steel needle. The syringe is provided with a piston to press the electronic device unit through the channel of hollow needle. After penetration of the animal skin by the tip of the needle to a certain depth and by pressing the piston the electronic device unit is forced through the channel of the hollow needle out of the needle under the animal skin where it remains after removal of the needle out of the skin.

This procedure has several disadvantages. So it may happen that when the needle is drawn backwards out of the skin the electronic device unit moves back through the open wound channel so that there is a deviation from the originally desired position. In some cases the electronic device unit may even slip out of the wound channel when the needle is drawn back. If the needle is made from stainless steel and the other parts of the syringe are made of a plastic material the insertion tool is very elaborate to produce. The needle made from stainless steel is also an expensive part of the syringe. Its disposal may need waste separation. Furthermore the electronic device unit which is hard may even in its desired position under the skin because of its hardness cause a nasty or an even painful feeling to the animal.

The object of the present invention is to avoid the technical disadvantages as discussed above.

The object is solved by an

Insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end and which

polymer or copolymer composition undergoes softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes. The gelatine-agarose-matrix test mimics in this case the in-vivo softening effect.

The insertion as described in here is easy to produce and easy to handle. It is also thermal resistant as shown in the temperature stability tests at air. The insertion part comprising a polymer or a copolymer composition in the form of a needle with an integrated electronic device unit remains under the skin and prevent any back movement. The polymer or a copolymer composition has the property to undergo softening after its insertion under the animal skin for five minutes. Thus the hard needle like polymer structure becomes soft and thus prevents or eases irritation and pain of the animal or other undesired reaction or perceptions compared to conventional insertion tools.

Figures

Figure 1/3: Schematic drawing showing an insertion tool comprising an insertion part (1) with a partially enveloped electronic device unit ((2), housing with inlay and chip) and a sharp tip end (3).

Figure 2/3:

- a) Schematic drawing showing an insertion tool comprising an insertion part (1) with an attached electronic device unit (2), a sharp tip end (3), a handling part (4) and a joining flange (5) consisting of the same material as the electronic device unit housing.
- b) Schematic drawing showing an insertion tool comprising an insertion part (1) with an attached electronic device unit (2), a sharp tip end (3), a handling part (4) and a joining flange (5) consisting of another material than the electronic device unit housing.

Figure 3/3:

- a) Schematic drawing showing an insertion tool comprising an insertion part (1) with a partially enveloped electronic device unit (2), a sharp tip end (3), a joining flange (5) consisting of the same material as the electronic device unit housing and a handling support (6) in the form of a syringe (7) with a piston (8).
- b) Schematic drawing showing an insertion tool comprising an insertion part (1) with a partially enveloped electronic device unit (2), a sharp tip end (3), a joining flange (5) consisting of another material than the electronic device unit housing and a handling support (6) in the form of a syringe (7) with a piston (8).

Detailed description of the invention

Insertion tool

The invention relates to an insertion tool comprising an insertion part suitable to be implanted in an animal or under the skin of an animal. The insertion part is comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end suitable to penetrate an animal skin and which polymer or copolymer composition undergoes softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes.

The invention also discloses an insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end, where the polymer or the copolymer composition comprises a (meth)acrylate copolymer polymerized out of 40 – 60 % by weight of ethyl acrylate and 40 – 60 % by weight of methacrylic acid.

The insertion tool will undergo softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes, which means that at least category 3 of the below explained categories 0 to 5 of visual and haptic properties should be reached.

Animals

Animals in the sense of the present invention shall be understood as various small animals, pets, domestic animals, like for instance mice, rats, cats, dogs or pony or animals for production (farm animals) like pigs, sheep, cattle or horses.

Suitability to penetrate an animal skin

The sharp tip end has the function to be capable to penetrate an animal skin, preferably with a force in the range of a force which is needed to penetrate an animal skin with a comparable conventional syringe equipped with a stainless steel needle. The suitability of the sharp tip end to penetrate an animal skin may be defined by the penetration of a membrane simulating an animal skin at a force of 150 N or less, preferably at a force of 50 – 140 N, at a speed of 100 mm/min.

Softening

The property of the polymer or a copolymer composition to undergo satisfactory softening can be tested by incubation in a test in water at 37 °C, in phosphate buffered saline (PBS) buffer, pH 7.4, 37 °C, or in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes.

Softening may be defined in that the sharp tip end of the polymer or a copolymer composition loses its sharpness to a degree that after removal from the buffered gelatine-agarose-matrix, pH 7.4, at 37° C after five minutes it has become far too soft to penetrate the skin of an animal, for instance the skin of a domestic cat animal. After softening it can be observed that the polymer or a copolymer composition swells and crumples all over which means at the previous sharp tip end but also at the handling part if present. If the test for softening is passed it is assumed that the polymer or a copolymer composition will undergo softening after being implanted under the skin of an animal as well, because of the similar physiological conditions.

Softening may also be defined in that the sharp tip end of the insertion part can no more penetrate a membrane simulating an animal skin at a force of 150 N at a speed of 100 mm/min.

Gelatine-Agarose-Matrix-Test (Material test for loosing sharpness in a gelatine-agarose matrix)

For the preparation of a gelatine-agarose matrix 17 g of PBS buffer is warmed up in a mL glass beaker to around 70 °C using a magnetic stirrer with heating plate. In a second step 3 g of agarose and 10 g of gelatine is added slowly while stirring and avoiding the formation of lumps. The mixture is stirred till it is completely solved in the PBS buffer. Then the weight is confirmed to 30 g and adjusted with PBS if needed, followed by the transfer of the mixture into a 50 mL Falcon tube and the cooling of it.

Prior to a trial to test the smoothening of a polymer or a copolymer composition (extrudate / sample), the agarose matrix is pre-warmed at 37 °C before the extrudate is inserted into the matrix and incubated with the matrix at 37 °C. The reaction of the extrudates and their properties should be observed and estimated with a visual and haptic classification from 0 to 5 time at points like 1 min / 5 min / 15 min / 30 min / 1 h / 24 h / incubation.

Tests in water or in PBS-buffer

Prior to a trial to test the smoothening of an polymer or a copolymer composition (extrudate / sample), the water or PBS-buffer is pre-warmed at 37 °C before the extrudate is layed in the water or PBS-buffer and incubated with the matrix at 37 °C. The reaction of the extrudates and their properties should be observed and estimated with a visual and haptic classification from 0 to 5 time at points like 1 min / 5 min / 15 min / 30 min / 1 h / 24 h / incubation.

Visual and haptic properties

Categories 0 to 5 of visual and haptic properties that may be tested in water at 37 °C, in phosphate buffered saline buffer, pH 7.4, 37 °C, or in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C to decide on the degree of softening. Usually the test in water at 37 °C, in phosphate buffered saline buffer, pH 7.4, 37 °C, or in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C give the same results. However since the test in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C resembles the animal tissue the most, this test is preferred.

0 = hard at room temperature and hard enough to be equipped with a sharp tip end to penetrate the skin of an animal (for instance the skin of dog)

1 = A little soft so it can be bended but reverses immediately to "0" when brought back to room temperature (20 – 25 °C, for instance 22 °C).

2 = More soft than "1" and contains no more sharp edges when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C

3 = Partially completely soft when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no reversion of the soft part in the wet stadium even at room temperature.

4 = Still in shape but completely soft mass when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no sharp edges, no reversion in the wet stadium even at room temperature, no more able to penetrate the skin of an animal (for instance the skin of a dog) if equipped with a sharp tip end.

5 = Completely soft mass has lost its original shape when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no reversion in the wet stadium

even at room temperature, no more able to penetrate the skin of an animal (for instance the skin of a dog) if equipped with a sharp tip end.

Rod-like handling part

The polymer or copolymer composition may optionally comprise a rod-like, preferably a longitudinal rod-like or a longitudinal cylindrical handling part which at least partially envelopes the electronic device unit (s. fig. 1 or 3). Thus the electronic device unit may be at least partially enveloped or attached to such a rod-like handling part.

Joining flange

The polymer or copolymer composition respectively the insertion tool may optionally comprise a cut-out structure which matches to the form of a joining flange fixed to the electronic device unit and where the electronic device unit may be joined, preferably joined tightly, by locking to the cut-out structure of the sharp tip end of the insertion part (s. Fig. 2/3 and 3/3). The cut-out structure and the joining flange of the electronic device unit may function together like a key-lock structure, in order to ensure a tight connection of both parts. The joining flange may be of the same material as the material of the electronic device unit housing or of another material than the housing, which for instance may be glued to the housing.

Many other mechanical designs for flanges are known, e.g. mechanical threads. The joining flange may be present in one embodiment where the insertion part does not envelope the electronic device unit. In this case no rod-like or longitudinal cylindrical handling part may be present.

The joining flange may be present in another embodiment where the insertion part does envelope the electronic device unit at least partially so that the partial envelope may represent a longitudinal cylindrical handling part.

No handling support

In a simple embodiment the insertion tool which is in this case identical to the insertion part may be pressed by the force of the hands or fingers under the skin the animal. In this case no handling support is needed.

Handling support

The insertion tool may further comprise a handling tool.

Simple handling support

A simple handling support may be a rod or a piston which can be grabbed and guided by hand and which can be put at the end of the insertion tool which then can be forced by the pressure of the rod or piston under the skin of an animal.

Syringe as handling support

In another embodiment the insertion tool may further comprise a handling support which is a syringe with a channel for the insertion part and a piston to force the insertion part with its sharp end first out of the channel to penetrate an animal skin (s. fig 3).

Handling support with a predetermined breaking point

In further embodiment the insertion tool may comprise a handling support which is physically a part of the insertion part. In this case the longitudinal cylindrical handling part may be prolonged beyond the position of the electronic device unit by the handling support and by a predetermined breaking point between the longitudinal cylindrical handling part containing the electronic device unit and the handling support. This allows the insertion tool to be handled at the handling support to

penetrate the skin of the animal with the sharp tip end first to a depth where the predetermined breaking point becomes covered by under the skin, and breaking the handling support away from the insertion part at the predetermined breaking point. Thus the handling support may be equipped with a predetermined breaking point.

Polymer or a copolymer composition

The insertion tool comprises an insertion part comprising a polymer or a copolymer composition in the form of a needle.

The polymer or copolymer composition may have a glass transition temperature from 30 – 90, from 25 to 35, from 28 to 37 or from 30 to 35 °C.

The glass transition temperature (T_g) may be determined by DSC (Differential Scanning Calorimetry) analysis. The determination of the glass transition temperature by DSC analysis or by other methods is well known to a skilled person.

The polymer or copolymer composition comprises a sharp tip end suitable to penetrate an animal skin and which polymer or copolymer composition undergoes softening after its insertion under the animal skin after five, four, three or two minutes.

The polymer or a copolymer composition may comprise a (meth)acrylate copolymer polymerized out of 40 – 60 % by weight of ethyl acrylate and 40 – 60 % by weight of methacrylic acid.

The polymer or a copolymer composition may comprise 5 to 40, preferably 8 to 25 % by weight of a plasticizer, calculated on the weight of the polymer or the copolymer composition.

The plasticizer may be triethyl citrate. Examples of suitable plasticizers are alkyl citrates, glycerol esters, alkyl phthalates, alkyl sebacates, sucrose esters, sorbitan esters, diethyl sebacate, dibutyl sebacate and polyethylene glycols 200 to 12 000. Further plasticizers are acetyl triethyl citrate (ATEC), diethyl sebacate and dibutyl sebacate (DBS).

The polymer or a copolymer composition may comprise 1 to 40, preferably 2 to 10 % by weight of a glidant.

The glidant may be Mg-stearate, silica (Syloid®) or talc.

Form of a needle

The polymer or a copolymer composition has the form of a needle. The form of a needle in the sense of the invention may be defined as at least comprising a sharp tip end and a more or less straight or flat end at the opposite of the tip. This is sufficient for instance for the case when the electronic device unit may be joined, by contact to a joining flange to the sharp tip end (s. fig. 2). Preferably the form of a needle is defined by comprising a longitudinal cylindrical handling part and a sharp tip end. This may be the case when the electronic device unit may be at least partially enveloped by the polymer or a copolymer composition. The sharp tip end is preferably not hollow as conventional needles made from stainless steel are. Because it is preferably not hollow its stability is improved compared to a hollow needle and is stable enough to penetrate the animal skin. Thus the polymer or a copolymer composition material does not need to be as stiff as stainless steel.

The sharp tip end may form an angle of 10 to 20, preferably 12 to 18°. Angle is meant in the sense that the lower the angle is, the sharper is the tip.

Thermal stability

The insertion tool as disclosed shall show a certain thermal stability. This is advantageous when the insertion tool shall be used under extreme hot or extreme cold environmental conditions. After incubation at 70 °C for one hour under air the polymer or copolymer composition may become a little soft but gets reversible hard enough again when the temperature is lowered again. Thus the insertion tool may endure hot temperatures for instance when it is stored in a car at summer

temperatures and can still be used to insert electronic devices under the skin of an animal after cooling down to a temperature range from 0 to 40 °C, preferably from 15 to 30 °C. The insertion may also endure cold temperatures maybe when it is stored at winter temperatures for instance below 0°C without becoming brittle and can still be used to insert electronic devices under the skin of an animal preferably after warming to a temperature range from 0 to 40 °C.

Biocompatible

The polymer or a copolymer composition shall be in general biocompatible which may be understood as non-toxic, of pharmaceutical grade, non-provoking irritations or allergic reactions when in contact with living organism, like animals. These characteristics are for instance fulfilled for polymer of the EUDRAGIT® type, for instance EUDRAGIT® L100-55, and mixtures thereof with excipients in pharmaceutical quality like glidants or plasticizers, for instance talc, Mg-stearate or triethylcitrate.

Electronic device unit

The electronic device unit is a unit which is typically intended to be implanted, preferably intended to be implanted under the skin of an animal. The electronic device unit may have a rod-like form and size, maybe 5 to 50 mm in length with a diameter of 1 to 10 mm. In some cases the electronic device unit may also have an irregular form which is suitable as long as the form and size allows it to be implanted, preferably to be implanted under the skin of an animal. The suitable size depends of on the size of the animal where the electronic device shall be implanted. In general comparatively small electronic devices are suitable for small animals while larger ones are suitable for bigger animals.

The electronic device unit may be a Radio Frequency Identification (RFID) chip unit, a sensor device unit, for instance for drug monitoring or for the measurement of vital functions or data, an implant containing a source for radiotherapy, a drug pump, for instance for insulin.

The electronic device unit a sensor platform for instance for a continuous long-term monitoring unit for the monitoring of several vital functions such as blood pressure, oxygen saturation, pulse, and perfusion. The electronic device unit may be a wireless readout unit which is electrical re-charging from the body temperature, a pH sensor, for instance intended to be part of a closed loop system inside of a patient which is able to react to pre-defined deviations of readings by neurostimulation or drug application. The electronic device unit may be a drug pump for instance for insuline and/or a drug monitoring device for instance for the blood glucose level. The electronic device unit may be combining microsystem technology, for instance devices used during cardiovascular surgery. The electronic device unit may be a RFID cross identification unit.

Insertion tool

The invention discloses an insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end, where the polymer or the copolymer composition comprises a (meth)acrylate copolymer polymerized out of 40 – 60 % by weight of ethyl acrylate and 40 – 60 % by weight of methacrylic acid.

This insertion tool will undergo softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes, which means that at least category 3 of the below mentioned categories concerning visual and haptic properties is reached.

The insertion tool may contain one or more active pharmaceutical ingredients, metabolites or nutritive compounds for example to improve wound closure.

Process

A suitable process for preparing the injection part of the injection tool is forming the polymer or a copolymer composition into a cylindrical, longitudinal form by

thermoplastic processing, adding a sharp tip end by cutting the extrudate and joining the extrudate with a electronic device unit. The resulting product may comprise at least a sharp tip end and a more or less straight or flat end at the opposite of the tip. The resulting product may also comprise a longitudinal cylindrical handling part and a sharp tip end. The resulting product may also comprise a joining flange structure for attaching a matching electronic device unit.

The process is preferably a thermoplastic processing such as extrusion moulding, injection moulding or injection pressure moulding. After thermoplastic processing processes such as edging, cutting, grinding, milling and shaping may be applied.

Use

The insertion tool as disclosed in here may be used for marking an animal with an integrated Radio Frequency Identification (RFID) chip unit.

The insertion tool may be used to be handled manually or by means of a handling support to force its insertion part to penetrate the skin of the animal with the sharp tip first to a depth where the handling part and the electronic device unit becomes completely covered by the skin of the animal.

Bio-Stopper

In another inventive embodiment the material is suitable for forming the insertion tool or the insertion part in the form of a needle as disclosed herein may be used to in the form of a cork or a stopper. The stopper which may have a rod-like or cylindrical form may then be used in a conventional steel needle equipped syringe inserted between the piston and the electronic device unit, for instance an RFID unit, to be implanted in an animal, for instance in the ear of a cow. The stopper will be pushed by the piston and itself pushes the electronic device unit through the channel of the steel needle. Both will be inserted into the animal tissue. Since the polymeric stopper material will

undergo softening under the influence of the animal tissue within five minutes, it then prevents as a (Bio-)stopper that the electronic device unit may slip back out of the wound channel and thus may get lost.

Thus the invention discloses the use of the material forming the insertion part as described herein comprising a polymer or a copolymer composition, as a rod-like formed stopper for use in a steel needle equipped syringe together with an electronic device unit suitable to be inserted together with the electronic device under the skin of an animal to prevent the slip back and loss of the electronic device unit through the wound channel.

Examples

Polymers

EUDRAGIT® E100 is a copolymer out of polymerized units of 25% by weight of methyl methacrylate, 25% by weight of butyl methacrylate and 50% by weight of dimethylaminoethyl methacrylate.

EUDRAGIT® S100 is a copolymer out of polymerized units of 70% by weight methyl methacrylate and 30% by weight methacrylic acid.

EUDRAGIT® L100 is a copolymer out of polymerized units of 50% by weight methyl methacrylate and 50% by weight methacrylic acid.

EUDRAGIT® L100-55 is a copolymer out of polymerized units of 50% by weight ethyl acrylate and 50% by weight methacrylic acid.

RESOMER® 203H is a Poly(D,L-lactide) polymer with an intrinsic viscosity in the range of 0.25 – 0.35

RESOMER® RG503 is a Poly(D,L-lactide-co-glycolide) 50:50 copolymer with an intrinsic viscosity in the range of 0.32 – 0.44

RESOMER® 858S is a Poly(D,L-lactide-co-glycolide) 85:15 copolymer with an intrinsic viscosity in the range of 1.3 – 1.7

Kollidon® CL is a crosslinked Polyvinylpyrrolidone (PVP) polymer

Extrusion of rods

Materials:

Materials for EUDRAGIT® extrusions

Product
EUDRAGIT® L 100-55
Triethyl citrate (TEC)

Materials for the test for loosing sharpness in a gelatine-agarose matrix

Product
Gelatine platinum, 240 Bloom
Agarose for DNA/RNA electrophoresis
Dulbecco's Phosphate Buffered Saline (D-PBS)

Overview devices for extrusion and injection moulding processes as well as analysis

Equipment
Heating cupboard
co-rotating twin screw extruder, strand granulation
Turbula mixer
Liquid dosaging
Prism Pharma air cooled conveying belt
Prism Pharma servo air varicut strand granulator
injection moulding device
safety work bench class II with UV-light sterilizer

Methods:

Melt extrusion of EUDRAGIT® polymers

The melt extrusion processes of the EUDRAGIT® L100-55 polymer mixtures were all performed on the Leistritz extruder with internal process control and automatic dosing. Triethyl citrate was dosed via a tubing pump into the extruder. The material in

general was dosed into the extruder with a feeding rate of 0.8 kg/h and the extrudate strands were collected on a conveying belt.

Extrusion was carried out at a temperature of approximately 140 °C and 130 rpm. Cylindric strands of 100 x 3 mm were collected for testing.

Test systems

Temperature stability at air test

In order to perform a short test according to the temperature stability of the melt extrudates, pieces of ~ 10 cm length were applied to a 15 mL Falcon tube and incubated for 30 min at 70 °C; for examples 7 and 8 a second trial with a 2 h incubation at 40 °C was performed as well.

The visual and haptic properties of the extrudates were observed and estimated with a visual and haptic classification after incubation for 30 min at 70°C and for 2h at 40°C respectively.

The temperature stability at air test is passed when the material does not undergo softening (not more than classification 1 = A little soft so it can be bended but reverses immediately to "0" when brought back to room temperature (20 – 25 °C, for instance 22 °C).

Gelatine-Agarose-Matrix-Test (Material test for loosing sharpness in a gelatine-agarose matrix)

For the preparation of the gelatine-agarose matrix 17 g of PBS buffer were warmed up in a mL glass beaker to ~ 70 °C using a magnetic stirrer with heating plate. In a second step 3 g of agarose and 10 g of gelatine were added slowly while stirring and avoiding the formation of lumps. The mixture was stirred till it was completely solved in the PBS buffer. Then the weight was confirmed to 30 g and adjusted with PBS if needed, followed by the transfer of the mixture into a 50 mL Falcon tube and the cooling of it.

Prior to a trial to test the smoothening of an extrudate / sample, the matrix was pre-warmed at 37 °C before the extrudate is inserted into the matrix and incubated with the matrix at 37 °C. The reaction of the extrudates and their properties were observed and estimated with a visual and haptic classification from 0 to 5: at time points like 1 min / 5 min / 15 min / 30 min / 1 h / 24 h / incubation.

PBS-buffer-test

The visual and haptic properties of the extrudates were observed and estimated with a visual and haptic classification from 0 to 5 at time points 0 and 5 min.

Examples 1 - 12

The individual Composition of extrudate examples 1 – 12 are summarized in table 1. The results of the temperature stability at air tests, the Gelatine-Agarose-Matrix-tests and the PBS-buffer-test are shown in table 2.

Explanation of the visual and haptic classification from 0 to 5:

0 = hard at room temperature and hard enough to be equipped with a sharp tip end to penetrate the skin of an animal (for instance the skin of dog)

1 = A little soft so it can be bended but reverses immediately to "0" when brought back to room temperature (20 – 25 °C, for instance 22 °C).

2 = More soft than "1" can and contains no more sharp edges when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C

3 = Partially completely soft when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no reversion of the soft part in the wet stadium even at room temperature.

4 = Still in shape but completely soft mass when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no sharp edges, no reversion in the wet stadium even at room temperature, no more able to penetrate the skin of an animal (for instance the skin of a dog) if equipped with a sharp tip end.

5 = Completely soft mass has lost its original shape when put out of the phosphate buffered saline buffer, pH 7.4, 37 °C, or phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C, no reversion in the wet stadium even at room temperature, no more able to penetrate the skin of an animal (for instance the skin of a dog) if equipped with a sharp tip end.

Example No.	E100	S100	L100	L100-55	TEC	talc	Mg-Stearate	Tg [°C]
1	100							n.d.
2		70			30			n.d.
3			60		40			n.d.
4			70		30			n.d.
5				60	40			n.d.
6				70	30			26.56
7				75	25			35.88
8				80	20			25.64
9				66.5	30	3.5		n.d.
10				63	30	7.0		19.62
11				66.5	30		3.5	30.00
12				71.25	25		3.75	29.44

Table 1: Composition of extrudate examples 1 - 12

n.d.= not determined, E100, S100, L100, L100-55 are abbreviations for the corresponding EUDRAGIT® polymers. TEC=triethylcitrate

Example No.	Temperature stability at air		Gelatine-Agarose-Matrix, 37 °C, [min]						PBS-buffer, 37 °C [min]	
	30 min / 70°C	2h / 40°C	0	1	5	15	60	1440 (24h)	0	5
1	1	n.d.	0	n.d.	n.d.	n.d.	n.d.	0	0	n.d.
2	1	n.d.	0	n.d.	n.d.	n.d.	n.d.	0	0	n.d.
3	1	n.d.	0	n.d.	n.d.	n.d.	n.d.	0	0	n.d.
4	1	n.d.	0	n.d.	n.d.	n.d.	n.d.	0	0	n.d.
5	1	n.d.	0	2	3	4	4	5	0	n.d.
6	1	n.d.	0	2	3	4	4	5	0	4
7	1	1	0	2	3	4	4	5	0	n.d.
8	1	1	0	2	3	4	4	5	0	n.d.
9	1	n.d.	0	2	3	4	4	5	0	n.d.
10	1	n.d.	0	2	3	4	4	5	0	n.d.
11	1	n.d.	0	2	3	4	4	5	0	n.d.
12	1	1	0	2	3	4	4	5	0	n.d.

Table 2: Test results of extrudates examples 1 – 12; n.d.= not determined

Results: Examples 5 to 12 (inventive), all of them containing the polymer EUDRAGIT® L100-55, showed satisfactory results. Examples 1 to 4 (comparative) containing the EUDRAGIT® polymers E100, S100, and L100 did not show satisfactory softening in Gelatine-Agarose-Matrix even after 24 hours.

Results for the RESOMER® polymer extrudates:

RESOMER® 203H

RESOMER® 203H + Kollidon® CL

RESOMER® RG503

RESOMER® RG503 + Kollidon® CL

RESOMER® 858S

The RESOMER® polymer extrudates including mixtures of RESOMER® RG503 and Kollidon® CL were not suitable for the purposes of the present invention because the extrudates did not change their hardness or the sharpness of edges during 24h of incubation in gelatine-agarose matrix at 37°C (classification "0").

Claims

1. Insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end and which polymer or copolymer composition undergoes softening after incubation in phosphate buffered gelatine-agarose-matrix, pH 7.4, at 37° C for five minutes.
2. Insertion tool comprising an insertion part suitable to be implanted in an animal, the insertion part comprising a polymer or a copolymer composition in the form of a needle with an attached or at least partially enveloped electronic device unit, and which polymer or copolymer composition comprises a sharp tip end, where the polymer or a copolymer composition comprises a (meth)acrylate copolymer polymerized out of 40 – 60 % by weight of ethyl acrylate and 40 – 60 % by weight of methacrylic acid.
3. Insertion tool according to Claim 1 or 2, wherein the electronic device unit is a Radio Frequency Identification (RFID) chip unit, a sensor device unit, an implant containing a source for radiotherapy or a drug pump.
4. Insertion tool to one or more of Claims 1 to 3, wherein the sharp tip is able to penetrate a membrane simulating an animal skin in at a force of 150 N or less at a speed of 100 mm/min.
5. Insertion tool unit according to one or more of Claims 1 to 4, wherein the sharp tip end of the insertion part is after incubation phosphate buffered saline, pH 7.4, at 37° C for five minutes no more capable to penetrate a membrane simulating an animal skin at a force of 150 N at a speed of 100 mm/min.

6. Insertion tool according to one or more of Claims 1 to 5, where the polymer or copolymer composition comprises a rod-like or longitudinal cylindrical handling part which at least partially envelopes the electronic device unit.
7. Insertion tool according to one or more of Claims 1 to 6, where the insertion tool comprises a cut-out structure which matches to the form of a joining flange fixed to the electronic device unit and where the electronic device unit may be joined by locking to the cut-out structure of the sharp tip end of the insertion part.
8. Insertion tool according to one or more of Claims 1 to 7, further comprising a handling support which is a syringe with a channel for the insertion part and a piston to force the insertion part with its sharp end first out of the channel to penetrate an animal skin.
9. Insertion tool, according to one or more of Claims 1 to 8, where the handling support is physically a part of the insertion part, whereby the longitudinal cylindrical handling part is prolonged beyond the position of the electronic device unit by the handling support and by a predetermined breaking point between the rod-like or longitudinal cylindrical handling part containing the electronic device unit and the handling support, allowing the insertion tool to be handled at the handling support to penetrate the skin of the animal with the sharp tip end first to a depth where the predetermined breaking point becomes covered by under the skin, and breaking the handling support away from the insertion part at the predetermined breaking point.
10. Insertion tool, according to one or more of Claims 1 or 3 to 9, where the polymer or the copolymer composition comprises a (meth)acrylate copolymer polymerized out of 40 – 60 % by weight of ethyl acrylate and 40 – 60 % by weight of methacrylic acid.
11. Insertion tool, according to one or more of Claim 1 to 10, where the polymer or a copolymer composition comprises 5 to 40 % by weight of a plasticizer.

12. Insertion tool, according to Claims 11, where the plasticizer is triethyl citrate.
13. Insertion tool, according to one or more of Claim 1 to 12, where the polymer or a copolymer composition comprises 1 to 40 % by weight of a glidant.
14. Insertion tool, according to Claims 13, where the glidant is Mg-stearate, silica or talc.
15. Insertion tool, according to one or more of Claim 1 to 14, wherein the polymer or copolymer composition has a glass transition temperature from 28 to 37 °C
16. Insertion tool, according to any of Claims 1 to 15, where the sharp tip end forms an angle of 10 to 20°.
17. Process for preparing the injection part of an insertion tool according to any of Claims 1 to 16 by forming the polymer or a copolymer composition into a longitudinal rod-like form by thermoplastic processing, adding a sharp tip end by cutting the extrudate and joining the extrudate to the electronic device unit.
18. Process according to Claim 17, whereby the thermoplastic processing is extrusion moulding, injection moulding or injection pressure moulding.
19. Use of an insertion tool according to one or more of Claims 1 to 16 for implanting an electronic device unit in an animal.
20. Use according to Claim 19, wherein the insertion tool is handled manually or by means of a handling support to force its insertion part to penetrate the skin of the animal with the sharp tip first to a depth where the handling part and the electronic device unit becomes completely covered by the skin of the animal.

21. Use of the material forming the insertion part according to one or more of Claims 1 to 16 comprising a polymer or a copolymer composition, as a rod-like formed stopper for use in a steel needle equipped syringe together with an electronic device unit suitable to be inserted together with the electronic device under the skin of an animal to prevent the slip back and loss of the electronic device unit through the wound channel.

Figure 1/3:

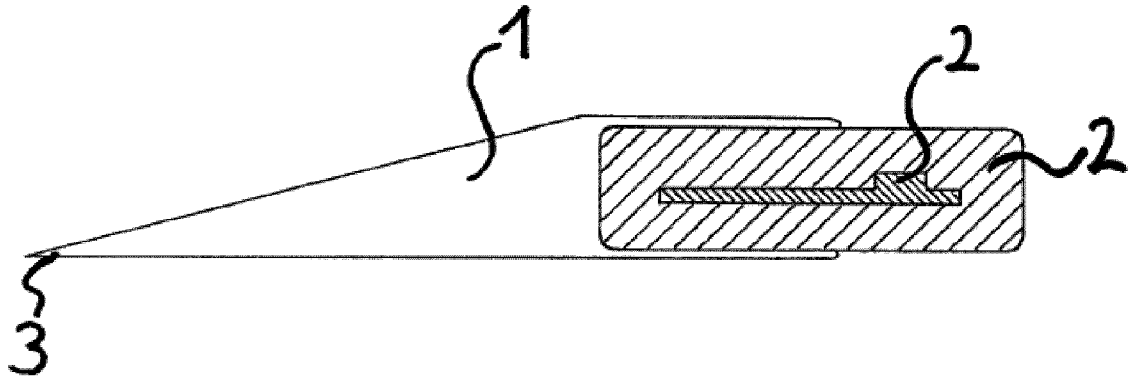
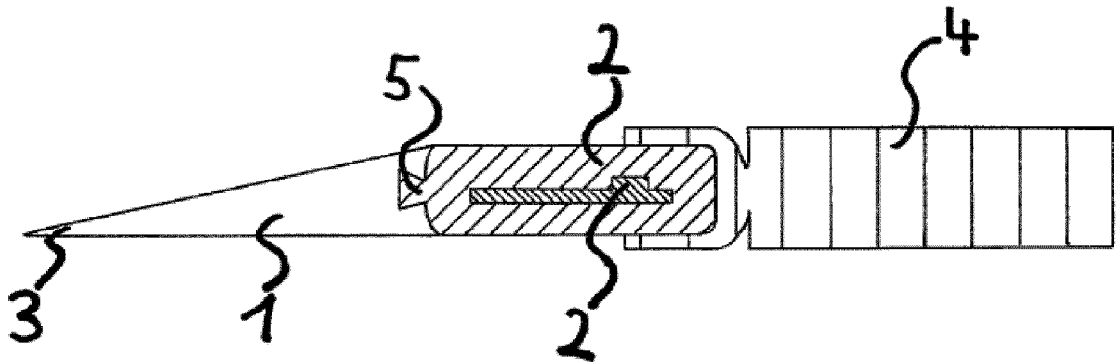


Figure 2/3:

a)



b)

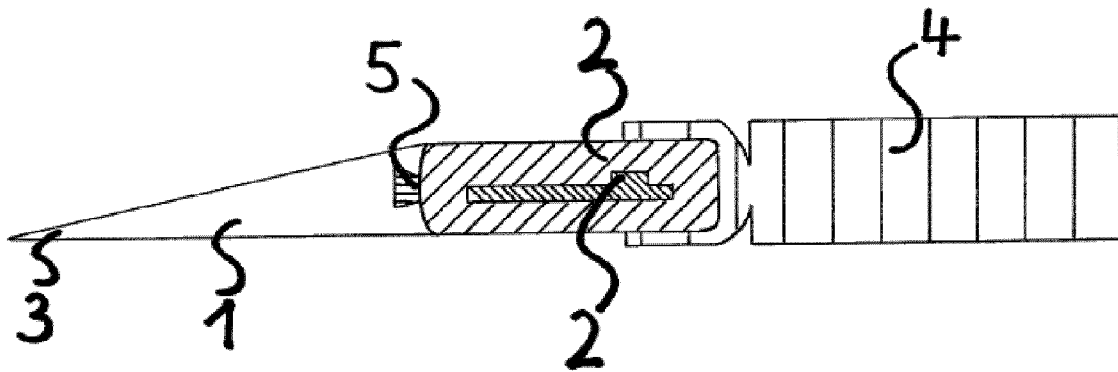
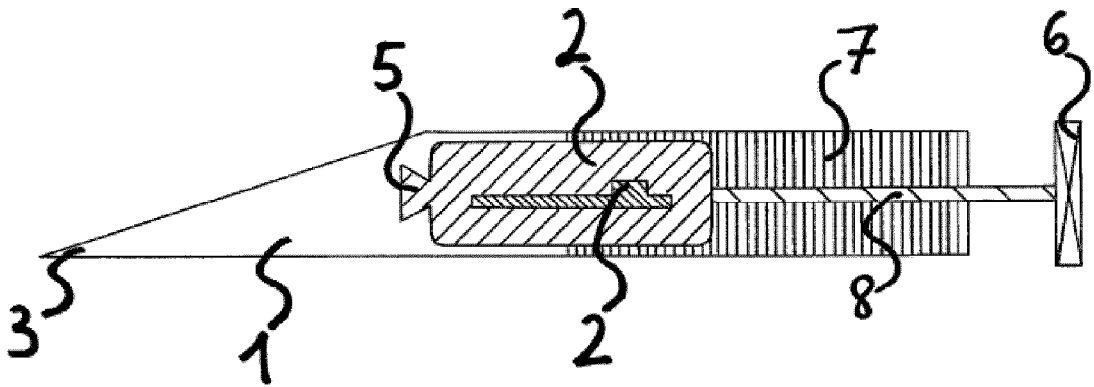
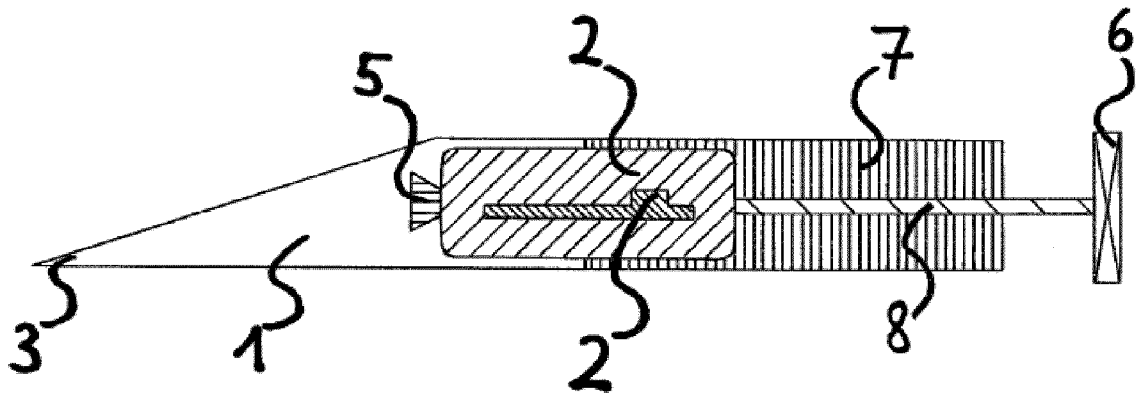


Figure 3/3:

a)



b)



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/050388

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01K11/00 A61D7/00 A61L31/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A01K A61D A61B A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/042849 A1 (SAITO ET AL.) 21 February 2008 (2008-02-21) cited in the application paragraphs [0053], [0067] - [0074], [0085] -----	1-18
X	US 2007/104753 A1 (FLANAGAN) 10 May 2007 (2007-05-10) paragraphs [0107] - [0111] paragraphs [0117], [0122], [0125] -----	1-18
X	US 2006/270922 A1 (BRAUKER ET AL.) 30 November 2006 (2006-11-30) claims 1,10; figures 2,5-9 paragraphs [0077], [0147], [0178] paragraphs [0268] - [0269], [0299] -----	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

25 November 2013

Date of mailing of the international search report

04/12/2013

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2013/050388

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 19-21
because they relate to subject matter not required to be searched by this Authority, namely:
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/050388

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008042849	A1	21-02-2008	CN 101129132 A 27-02-2008
			EP 1892649 A2 27-02-2008
			JP 2008043302 A 28-02-2008
			KR 20080017247 A 26-02-2008
			TW 200823766 A 01-06-2008
			US 2008042849 A1 21-02-2008

US 2007104753	A1	10-05-2007	CA 2628405 A1 18-05-2007
			EP 1948265 A2 30-07-2008
			JP 2009514598 A 09-04-2009
			US 2007104753 A1 10-05-2007
			WO 2007056073 A2 18-05-2007

US 2006270922	A1	30-11-2006	US 2006270922 A1 30-11-2006
			US 2006270923 A1 30-11-2006
			US 2007027370 A1 01-02-2007
			US 2007045902 A1 01-03-2007
			US 2009036763 A1 05-02-2009
			WO 2006127694 A2 30-11-2006
			WO 2007136390 A1 29-11-2007
