sensing attachment also has a body, where in one example the body is adapted to reversibly attach to and detach from the medical device. For example, when the medical device is as stent graft or a graft, the body may be adapted to fit around the outside of a graft or stent graft in a reversible manner, or the body may be adapted to fit around the inside of a graft or stent graft in a reversible manner, i.e., the sensing attachment can be attached to and detached from the graft or stent graft. In one example, the sensor is directly attached to the body. In one example the sensor is not directly attached to the body, but is connected to the body indirectly, e.g., by a wire that runs between the body and the sensor or a housing that contains the sensor.

**[0009]** In one example, the sensing attachment has an elastic or super-elastic body. For example, the body may be made from an elastic polymer, or a super-elastic metal alloy such as nitinol. By being elastic or super-elastic, the body may be expanded to fit around the outside of a medical device, and then released from its expanded size to then fit snugly against an outside surface of the medical device. By being elastic or super-elastic, the body may be compressed to fit inside a medical device, and then released from its compressed size to then fit snugly against an inside surface of the medical device. In this way, the body may adopt a shape that fits around a tubular medical device such as a graft or a stent graft.

**[0010]** In one example, the sensing attachment has a body in the shape of a spring. A body in the shape of a spring can fit around the inside or outside of a graft or a stent graft, and be held in place against a surface of the medical device by way of hoop stress.

**[0011]** In one example, the body is a size-adjustable body that can conform to a size and shape of the medical device to which it is associated. In order to be shape-adjustable, the body may be formed from an elastic material, such as an elastic polymer, or a super-elastic metal alloy such as nitinol. In addition, or alternatively, in order to be size-adjustable, the body may have a form and shape that is amenable to adjusting in size, such as a spring or a clip.

**[0012]** In one aspect, the present disclosure refers to a sensing attachment for a medical device, the attachment comprising: a) a sensor; b) a communication interface configured to provide intra-body communication to another device; and at least one of: i) an elastic or super-elastic body having a shape that fits around a tubular medical device such as a graft or stent graft; ii) a body in the shape of a spring formed from nitinol; and/or iii) a size-adjustable body that can conform to a size and shape of the medical device. Thus, in one example, the present disclosure provides a sensing attachment for a medical device, where the attachment comprises a sensor and a body, as well as a communication interface configured to provide intra-body communication to another device. The body may be further described as providing one or more of: the body being adapted to reversible attach to and detach from the medical device; the body being an elastic or super-elastic body having a shape that fits around either an inside surface or an outside surface of a tubular medical device such as a graft or stent graft; the body being made from

15. A kit comprising a sensing attachment for a medical device, and a medical device that may be associated with the sensing attachment, the kit comprising:
    a) a sensing attachment comprising:
        1. a sensor;
        2. a size-adjustable body that can conform to a size and shape of the medical device; and
        3. a communication interface configured to provide intra-body communication to another device; and
    b) a medical device selected from a graft and a stent graft.

**[0016]** In another aspect, the present disclosure refers to a kit comprising the sensing attachment as disclosed herein and a stent graft, or a graft. In another aspect, the present disclosure refers to a system comprising the sensing attachment as disclosed herein associated with a stent graft, or a graft. In another aspect, the present disclosure refers to an apparatus comprising the sensing attachment as disclosed herein associated with a graft, the system located within the delivery catheter; or the system comprising the sensing attachment as disclosed herein associated with a stent graft, the system located within a delivery catheter. In another aspect, the present disclosure refers to an apparatus comprising: a) a delivery catheter having proximal and distal ends and having a lumen extending there through, the lumen having a length and a cross-sectional area; b) a sensing attachment as disclosed herein in a compressed state, the compressed sensing attachment located entirely within the lumen of the delivery catheter; c) a push rod slidably disposed within the lumen of the delivery catheter, the push rod adjacent to and not within the compressed sensing attachment; and d) a distal movable sheath that covers a first portion of the length of lumen of the delivery catheter, where the first portion of the lumen contains a first portion of the push rod and a first portion of the sensing attachment in a compressed state; where the slidably disposed push rod is engaged with the distal movable sheath such that sliding of the push rod causes movement of the movable sheath, where the movement exposes the first portion of the compressed sensing attachment and thereby allows the compressed sensing attachment to achieve a less compressed form. In one example, the present disclosure provides an apparatus comprising a sensing attachment that is located within a delivery catheter. In one example, the present disclosure

provides an apparatus comprising a system and a delivery catheter, where the system comprises a sensing attachment that is associated with a graft, and where the system is located within the delivery catheter. In one example, the present disclosure provides an apparatus comprising a system and a delivery catheter, where the system comprises a sensing attachment that is associated with a stent graft, where the system located within the delivery catheter. For example, in one example, the present disclosure provides an apparatus comprising: a) a delivery catheter having proximal and distal ends and having a lumen extending therethrough, the lumen having a length and a cross-sectional area; b) a sensing attachment in a compressed state, the compressed sensing attachment located entirely within the lumen of the delivery catheter; c) a push rod slidably disposed within the lumen of the delivery catheter, the push rod adjacent to and not within the compressed sensing attachment; and d) a distal movable sheath that covers a first portion of the length of lumen of the delivery catheter, where the first portion of the lumen contains a first portion of the push rod and a first portion of the sensing attachment in a compressed state; where the slidably disposed push rod is engaged with the distal movable sheath such that sliding of the push rod causes movement of the movable sheath, where the movement exposes the first portion of the compressed sensing attachment and thereby allows the compressed sensing attachment to achieve a less compressed form.

**[0017]** In one aspect, the present disclosure refers to a method of manufacture of a sensing attachment as disclosed herein, comprising: a) forming a body of a sensing attachment , where the body is at least one of: i) an elastic or super-elastic body having a shape that fits around a tubular medical device such as a graft or stent graft; ii) a body in the shape of a spring formed from nitinol; and/or iii) a size-adjustable body that can conform to a size and shape of the medical device; b) forming an electronics assembly including a sensor and a communication interface; c) forming a power supply ; d) electrically coupling and fixedly attaching the power supply to the electronics assembly ; and e) fixedly attaching the electronics assembly and the power supply to the body of the sensing attachment, particularly wherein: the body is formed by shape setting a nitinol filament; or wherein the body is in a form of a spring that has a size and shape to fit around a stent graft and be held against an outer surface of the stent graft by hoop stress; or wherein the body is in a form of a spring that has a size and shape to fit inside a stent graft and be held against an inner surface of the stent graft by hoop stress.

In one example, the present disclosure provides a method of manufacture of a sensing attachment, where the method comprises: a) forming a body of a sensing attachment, where the body is at least one of: i) a body adapted to reversibly attach to and detach from the medical device; ii) an elastic or super-elastic body having a shape that fits around a tubular medical device such as a graft or stent graft; iii) a body in the shape of a spring formed from nitinol; and/or iv) a size-adjustable body that can conform to a size and shape of the medical device; b) forming an electronics assembly including a sensor and a communication interface; c) forming a power supply; d) electrically coupling and fixedly attaching the power supply to the electronics assembly; and e) fixedly attaching the electronics assembly and the power supply to the body of the sensing attachment. Optionally, the body is formed by shape setting a nitinol filament. Optionally, the body is in a form of a spring that has a size and shape to fit around a stent graft and be held against an outer surface of the stent graft by hoop stress. Optionally, the body is in a form of a spring that has a size and shape to fit inside a stent graft and be held against an inner surface of the stent graft by hoop stress.

**[0018]** In another aspect, the present disclosure refers to a method for associating a sensing attachment to a medical device in a secure manner *in vitro*, the method comprising: a) selecting a medical device from the group consisting of a graft and a stent graft, where the medical device has an inner diameter and an outer diameter; b) selecting a sensing attachment as disclosed herein having an inner diameter and an outer diameter, where at least one of (i) the inner diameter of the sensing attachment is essentially the same as the outer diameter of the medical device; and (ii) the outer diameter of the sensing attachment is essentially the same as the inner diameter of the medical device; c) placing the sensing attachment either within or outside of the medical device in vitro, where hoop stress secures the sensing attachment to the medical device. In another aspect, the present disclosure refers to a method for making a system comprising a medical device having a sensing attachment located within

the medical device, the method comprising: a) providing a medical device selected from the group consisting of a graft and a stent graft, the medical device having an inside and an outside; b) determining an inner diameter of the medical device; c) selecting a sensing attachment as disclosed herein having an inside and an outside, the outside having an outer diameter, where the outer diameter of the sensing attachment is essentially the same as the inner diameter of the medical device; d) compressing the sensing attachment from a non-compressed state to a compressed state to thereby decrease the inner diameter of the sensing attachment and provide a compressed state of the sensing attachment; e) placing the sensing attachment in the compressed state inside the medical device at a location having the inner diameter; f) returning the sensing attachment to a non-compressed state, so that the outside of the sensing attachment contacts the inside of the medical device, to provide a system comprising a medical device having a sensing attachment located within the medical device. In another aspect, the present disclosure refers to a method for making a system comprising a medical device and a sensing attachment located external to the medical device, the method comprising: a) providing a medical device selected from the group consisting of a graft and a stent graft, the medical device having an inner surface and an outer surface; b) selecting a sensing attachment as disclosed herein having an inside and an outside, the inside having an inner diameter, where the inner diameter of the sensing attachment is larger than the outer diameter of the medical device; and c) placing the sensing attachment around the medical device. In yet another aspect, the present disclosure refers to a method for collecting information from a patient, the method comprising: a) obtaining information using a sensor secured to a sensing attachment as disclosed herein, the sensing attachment physically associated with, but not a component of, a medical device that is implanted in the patient, the medical device selected from a stent graft and a graft; and b) transmitting the information or a modified form thereof to a device located outside of the patient. In one example, the present disclosure provides a method for associating a sensing attachment with a medical device, for example by a method according to any of the following numbered examples:

1. A method for associating a sensing attachment to a medical device in a secure manner *in vitro*, the method comprising:
    a) selecting a medical device from the group consisting of a graft and a stent graft, where the medical device has an inner diameter and an outer diameter;
    b) selecting a sensing attachment having an inner diameter and an outer diameter, where at least one of (i) the inner diameter of the sensing attachment is essentially the same as the outer diameter of the medical device; and (ii) the outer diameter of the sensing attachment is essentially the same as the inner diameter of the medical device;
    c) placing the sensing attachment either within or outside of the medical device *in vitro*, where hoop stress secures the sensing attachment to the medical device.
2. A method for making a system comprising a medical device having a sensing attachment located within the medical device, the method comprising:

CLAIMS

What is claimed is:

1. A sensing attachment for a medical device, the attachment comprising:
    a) a sensor;
    b) a communication interface configured to provide intra-body communication to another device; and at least one of:
        i) an elastic or super-elastic body having a shape that fits around a tubular medical device such as a graft or stent graft;
        ii) a body in the shape of a spring formed from nitinol; and/or
        iii) a size-adjustable body that can conform to a size and shape of the medical device.

2. The sensing attachment of claim 1, wherein the body is adapted to reversibly attach to and detach from the medical device.

3. The sensing attachment of claim 1 or 2, wherein the body is in a form of a solid or hollow filament ; or wherein the body is in a form of a monofilament or multifilament; or wherein the body is in a form of a hollow filament ; or wherein the body is in a form of a hollow filament comprising nitinol, where the hollow filament has a lumen; or wherein the body is in a form of a hollow filament comprising nitinol, where the hollow filament has a lumen surrounded by a wall of the hollow filament , where the wall has an inner surface facing the lumen and an outer surface facing away from the lumen, and where the hollow filament has a plurality of cuts along its length, each cut extending from the outer surface of the hollow filament into the lumen of the hollow filament; or wherein the body is in a form of a hollow filament comprising nitinol, where the hollow filament has a lumen surrounded by a wall of the hollow filament , where the wall has an inner surface facing the lumen and an outer surface facing away from the lumen, and where the hollow filament has a plurality of cuts along its length, each cut

extending from the outer surface of the hollow filament

into the lumen of the hollow filament , wherein the plurality of cuts are separated from one another by 1 to 20 mm; or wherein the body is in a form of a plurality of rings; or wherein the body is in a shape of a spring ; or wherein the body is in a shape of a spring running in a clockwise direction; or wherein the body is in a shape of

a spring running in a counterclockwise direction; or wherein the body is in a shape of a clip ; or wherein the body is in a shape of a ring; or wherein the body comprises a hollow monofilament in a shape of a spring ; or wherein the body is in a shape of a clamp or a cuff bracelet; or wherein the sensing attachment is biocompatible; or wherein the body is elastic or super-elastic; or wherein the body comprises a shape-memory material; or wherein the body comprises nitinol; or wherein the body comprises an elastomeric plastic; or wherein the body has a size and shape that allows it to fit around and against an outer surface of a stent graft; or wherein the body has a size and shape that allows it to fit around and against an inner surface of a stent graft; or wherein the body has a size and shape that allows it to fit around and against an inner surface of a graft; or in a compressed form that fits inside of a delivery catheter for percutaneous delivery to a patient; or wherein the body comprises a polymeric coating on a surface of the body; or wherein the body comprise a lubricious coating on a surface of the body; or wherein a sleeve is positioned around at least a portion of the surface of the body; or wherein the sensor is selected from a fluid pressure sensor, fluid volume sensor, contact sensor, position sensor, pulse pressure sensor, blood volume sensor, blood flow sensor, chemistry sensor, metabolic sensor , accelerometer, mechanical stress sensor and temperature sensor; or wherein the sensor is a pressure sensor; or wherein the sensor is a plurality of pressure sensors; or wherein the sensor is a MEMS sensor; or wherein the sensor is hermetically sealed; or further comprising a power supply; or further comprising a power supply and an electronics assembly having various circuitry powered by the power

supply , the electronics assembly comprising one or more of components selected from a fuse , a switch , a clock generator and power management unit , a memory and a controller ; or wherein the communication interface comprises a radio frequency (RF) transceiver and a filter , that couple with an antenna ; or wherein the communication interface comprises tissue conductive communication circuitry that couples with a pair of electrodes ; or wherein the communication interface comprises data-over-sound circuitry that couples with an acoustic transducer .

4. A kit comprising the sensing attachment of any one of claims 1-3 and a stent graft; or a graft.

5. A system comprising the sensing attachment of any one of claims 1-3 associated with a stent graft; or a graft.

6. An apparatus comprising the sensing attachment of any one of claims 1-3 located within a delivery catheter.

7. An apparatus comprising a system and a delivery catheter, the system comprising the sensing attachment of any one of claims 1-3 associated with a graft, the system located within the delivery catheter; or the system comprising the sensing attachment of any one of claims 1- 3 associated with a stent graft, the system located within the delivery catheter.

8. An apparatus comprising:

a) a delivery catheter having proximal and distal ends and having a lumen extending there through, the lumen having a length and a cross-sectional area;

b) a sensing attachment of any one of claims 1-3 in a compressed state, the compressed sensing attachment located entirely within the lumen of the delivery catheter;

c) a push rod slidably disposed within the lumen of the delivery catheter, the push rod adjacent to and not within the compressed sensing attachment; and

d) a distal movable sheath that covers a first portion of the length of lumen of the delivery catheter, where the first portion of the lumen contains a first portion of the push rod and a first portion of the sensing attachment in a compressed state;

where the slidably disposed push rod is engaged with the distal movable sheath such that sliding of the push rod causes movement of the movable sheath, where the movement exposes the first portion of the compressed sensing attachment and thereby allows the compressed sensing attachment to achieve a less compressed form.

9. A method of manufacture of a sensing attachment of any one of claims 1-3, comprising:

a) forming a body of a sensing attachment , where the body is at least one of:

i) an elastic or super-elastic body having a shape that fits around a tubular medical device such as a graft or stent graft;

ii) a body in the shape of a spring formed from nitinol; and/or

iii) a size-adjustable body that can conform to a size and shape of the medical device;

b) forming an electronics assembly including a sensor and a communication interface;

c) forming a power supply ;

d) electrically coupling and fixedly attaching the power supply to the electronics assembly ; and

e) fixedly attaching the electronics assembly and the power supply to the body of the sensing attachment ,

particularly wherein:

the body is formed by shape setting a nitinol filament; or wherein the body is in a form of a spring that has a size and shape to fit around a stent graft and be held against an outer surface of the stent graft by hoop stress; or wherein the body is in a form of a spring that has a size and shape to fit inside a stent graft and be held against an inner surface of the stent graft by hoop stress.

10. A method for associating a sensing attachment to a medical device in a secure manner *in vitro*, the method comprising:
    a) selecting a medical device from the group consisting of a graft and a stent graft, where the medical device has an inner diameter and an outer diameter;
    b) selecting a sensing attachment of any one of claims 1-3 having an inner diameter and an outer diameter, where at least one of (i) the inner diameter of the sensing attachment is essentially the same as the outer diameter of the medical device; and (ii) the outer diameter of the sensing attachment is essentially the same as the inner diameter of the medical device;
    c) placing the sensing attachment either within or outside of the medical device *in vitro*, where hoop stress secures the sensing attachment to the medical device.

11. A method for making a system comprising a medical device having a sensing attachment located within the medical device, the method comprising:
    a) providing a medical device selected from the group consisting of a graft and a stent graft, the medical device having an inside and an outside;
    b) determining an inner diameter of the medical device;

c) selecting a sensing attachment of any one of claims 1-3 having an inside and an outside, the outside having an outer diameter, where the outer diameter of the sensing attachment is essentially the same as the inner diameter of the medical device;

d) compressing the sensing attachment from a non-compressed state to a compressed state to thereby decrease the inner diameter of the sensing attachment and provide a compressed state of the sensing attachment;

e) placing the sensing attachment in the compressed state inside the medical device at a location having the inner diameter;

f) returning the sensing attachment to a non-compressed state, so that the outside of the sensing attachment contacts the inside of the medical device, to provide a system comprising a medical device having a sensing attachment located within the medical device.

12. A method for making a system comprising a medical device and a sensing attachment located external to the medical device, the method comprising:

a) providing a medical device selected from the group consisting of a graft and a stent graft, the medical device having an inner surface and an outer surface;

b) selecting a sensing attachment of any one of claims 1-3 having an inside and an outside, the inside having an inner diameter, where the inner diameter of the sensing attachment is larger than the outer diameter of the medical device; and

c) placing the sensing attachment around the medical device.

13. A method for collecting information from a patient, the method comprising:

a) obtaining information using a sensor secured to a sensing attachment of claim 1, the sensing attachment physically associated with, but not a component of, a medical device that is implanted in the patient, the

medical device selected from a stent graft and a graft; and

b) transmitting the information or a modified form thereof to a device located outside of the patient.