DISCRETE ACTIVE SEAL ASSEMBLIES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a Divisional Application of U.S. application Ser. No. 11/074,575 filed Mar. 8, 2005 and relates to and claims priority to U.S. Provisional Application No. 60/552,781 entitled, "Active Seal Assemblies" filed on Mar. 12, 2004, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] This disclosure relates to seals and more particularly, to discrete active seal assemblies for sealing opposing surfaces.

[0003] Current methods and assemblies for sealing opposing surfaces such as doors and trunk lids, for example, include the use of flexible elastic membranes and structures that compress upon pressing into the opposing surfaces to close the gap between surfaces. Typical materials include various forms of elastomers, e.g., foams and solids, that are formed into structures having solid and/or hollow cross sectional structures. The geometries of the cross sections are varied and may range from circular forms to irregular forms having multiple cavities, channels, slots and/or extending vanes.

[0004] Sealing assemblies are typically utilized for sound, airflow, and/or fluid management. The seals generally are exposed to a variety of conditions. For example, for vehicle applications, door seals generally are exposed to a wide range of environmental conditions such as rain, snow, sun, humidity and temperature conditions, and the like. Current materials utilized for automotive seals are passive. That is, other than innate changes in modulus of the seal material due to aging and environmental stimuli, the stiffness and cross sectional geometries of the seal assemblies cannot be remotely changed or controlled on demand.

[0005] A problem with current seals is the tradeoff in seal effectiveness. Seal effectiveness can generally be increased by increasing the interface pressure and/or contact area of the seal. However, in sealing applications, such as in vehicle doors, the increased interface pressure and/or contact area by non-active seals results in increased door opening and closing efforts.

[0006] Accordingly, it is desirable to have active seal assemblies that can be controlled and remotely changed to alter the seal effectiveness, wherein the active seal assemblies change stiffness properties on demand, for example, by changing the material's elastic modulus, or geometry, for example by actively changing the cross-sectional shape of the seal. In this manner, in seal applications such as the vehicle door application noted above, door opening and closing efforts can be minimized yet seal effectiveness can be maximized.

BRIEF SUMMARY

[0007] Disclosed herein are active seal assemblies. In one embodiment, the active seal assembly comprises a seal body formed of an elastic material integrated with a seal base; a wire and/or strip partially embedded within the seal body having an end that exits the seal body, wherein the partially embedded wire and/or strip is positioned within the seal body such that a shape of the seal body changes in response to a force exerted on the wire and/or strip; an active material in operative communication with the end of the wire and/or strip, wherein the active material is effective to undergo a change in at least one attribute in response to an activation signal, wherein the change in the at least one attribute exerts the force on the wire and/or strip; an activation device in operative communication with the active material adapted to provide the activation signal; and a controller in operative communication with the activation device.

[0008] In another embodiment, the active seal assembly comprises a seal body formed of an elastic material integrated with a seal base, wherein the seal body comprises a hollow interior channel; a wire or strip disposed within the hollow interior channel comprising a plurality of stiff elements directly attached to the seal body and the wire or strip; an active material in operative communication with the end of the wire or strip, wherein the active material is effective to undergo a change in at least one attribute in response to an activation signal, wherein the change in the at least one attribute exerts a force on the wire or strip such that a shape of the seal body changes in response to a force exerted on the wire or strip; an activation device in operative communication with the active material adapted to provide the activation signal; and a controller in operative communication with the activation device.

[0009] In yet another embodiment, the active seal assembly comprises a seal body formed of an elastic material integrated with a seal base, wherein the seal body comprises a hollow interior channel; a fluid disposed within the hollow interior channel, wherein the fluid is in operative communication with an active material whereby the fluid effectively undergoes a change in at least one attribute in response to an activation signal, wherein the change in the at least one attribute changes a shape of the seal body; an activation device in operative communication with the active material adapted to provide the activation signal; and a controller in operative communication with the activation device.

[0010] In still another embodiment, the active seal assembly comprises a seal body; a movable element disposed to slide within the seal body, wherein the movable element comprises an active material adapted to selectively move the element from a first position to a second position in response to an activation signal and change a shape of the seal body; an activation device in operative communication with the active material adapted to provide the activation signal; and a controller in operative communication with the activation device.

[0011] The above described and other features are exemplified by the following figures and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Referring now to the figures, which are exemplary embodiments and wherein like elements are numbered alike:

[0013] FIGS. **1** and **2** illustrate contracted and expanded lengthwise sectional views, respectively, of a discrete active seal assembly in accordance with one embodiment;

[0014] FIGS. **3** and **4** illustrate contracted and expanded end-on sectional views, respectively, of a discrete active seal assembly in accordance with another embodiment;