industries to protect the device or substrate from a variety of environments. Non-limiting examples of potential uses include coatings and methods that allow for protection of electronic devices from harsh environments and contaminates, such as particulates including dust and dirt, as well as liquids, including water and bodily fluids. Furthermore, there is a need for a coating that can be applied without the need to mask components, such as on a printed circuit board, prior to coating. There is also a need for a durable, deformable, and flowable coating that can cover an entire printed circuit board, without inhibiting the functionality of the device.

Summary

[008] In view of the foregoing, there is disclosed a composition that is used to form a durable gel-state coating to protect a device or substrate, methods of making such a coating and methods of using such a coating, as well as devices and substrates protected with such a coating.

[008a] In an aspect, there is provided a composition for forming a conformal gel coating to protect a substrate , the composition comprising:

at least one film former comprising at least one of polyolefins, polyacrylates, polyurethanes, epoxies, polysiloxanes, or combinations thereof;

at least one additive;

wherein said composition is configured to form a conformal gel coating that is deformable, flowable, and electrically insulating.

[008b] In another aspect, there is provided a conformal gel coating to protect an electronic element , the coating comprising:

at least one film former which comprises at least one of polyolefins, polyacrylates, polyurethanes, epoxies, polysiloxanes or combinations thereof;

at least one additive,

wherein said gel coating is deformable, flowable, and electrically insulating.

[008c] In another aspect, there is provided a method of treating an electronic device with a conformal gel coating, the method comprising:

applying the conformal gel coating to the electronic device, wherein the conformal gel coating comprises: at least one film former which comprises at least one of polyolefins, polyacrylates, polyurethanes, epoxies, polysiloxanes or combinations thereof, at least one additive,

wherein said conformal gel coating is deformable, flowable and electrically insulating.

[008d] In another aspect, there is provided a substrate having a conformal gel coating thereon, the conformal gel coating comprising: at least one film former comprising at least one of polyolefins, polyacrylates, polyurethanes, epoxies, polysiloxanes or combinations thereof; and at least one additive, wherein the conformal gel coating is deformable, flowable, and electrically insulating.

[009] In one ~~embodiment~~example, there is disclosed a composition for forming a conformal gel coating to protect a substrate from various environments, the composition comprising: at least one film former; and at least one additive and optionally at least one solvent, wherein the composition is deformable, flowable, electrically insulating, and does not contain fluorine when applied as a coating.

[010] There is also disclosed a conformal gel coating to protect an electronic element from various environments, the coating comprising: at least film former; and at least one additive and optionally at least one solvent, wherein the gel coating is deformable, flowable, electrically insulating, and does not contain fluorine.

[011] In another ~~embodiment~~example, there is disclosed a method of treating an electronic device with a gel conformal coating, the method comprising: applying the gel conformal coating to the electronic device, the gel conformal coating comprising

a film former, and an additive, the coating composition optionally further comprising at least one solvent, dye, pigment or combinations thereof.

[012] In yet another ~~embodiment~~example, there are disclosed various devices or substrates on which the coating is applied. These devices or substrates may include an automotive part or a printed circuit board, with a gel-state coating described herein. The gel-state coating described herein is made from a composition comprising: at least one film former, and at least one additive that improves at least one of the mentioned performance properties of the coating.

Brief Description of the Drawings

[013] The accompanying figures, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and together with the description, serve to explain the principles of the invention.

[014] **FIG. 1** is a flow chart showing a representative antioxidant (AO) additive action mechanism according to a disclosed embodiment.

[015] **FIG. 2** is a schematic showing surface insulation resistance measurement set-up.

[016] **FIG. 3** shows a schematic demonstrating migration of additive from coating to the coating/substrate interface to prevent degradation of the coating or substrate.

[017] **FIG. 4** shows a schematic demonstrating migration of additive from coating to coating/air interface to prevent degradation of the coating or substrate.

[018] **FIG. 5** shows a schematic demonstrating stepwise application of various additives.