Another class of soldering material that has been proposed is thermoset-based material. Unfortunately, thermosets suffer from poor reflowability or may not be reflowable without chemical degradation after curing. For this reason, thermosets may be incompatible with 3D printing pens that are used to solder 3D-printed electronic components or circuits.

Other explored materials tend to be unstable when stored at ambient atmospheres and temperatures, which also render transportation of these materials difficult. For instance, thermoset-based solder often comes as a two-part solution that needs to be premixed before used. If it comes as a one part pre-polymeric composite, non-ambient conditions may be required for storage (e.g. less than 0ºC). Thus, two-part-based thermoset solders tend to be cumbersome while one-part-based thermoset solder may be limited by their portability.

There is a need to provide a soldering method that involves a soldering material which is capable of overcoming, or at least ameliorating, one or more of the disadvantages described above. There is also a need to provide a soldering material for use in making the soldering process easier and less cumbersome compared to conventional soldering techniques involving conventional soldering materials.

The provided method involving the provided soldering material needs to be capable of removably securing a non-metallic component to a metallic or non-metallic component or substrate while circumventing or mitigating the above limitations.

Summary ~~of Invention~~

~~According to one aspect, t~~There is provided a method for soldering a first non-metallic component to one or more metallic or non-metallic component, the method comprising the step of removably securing the first non-metallic component to the one or more metallic component by using a conductive polymeric composite; or removably securing the first non-metallic component to the one or more non-metallic component by using the conductive polymeric composite, wherein the conductive polymeric composite used in the method comprises a blend of at least one filler material and at least one thermoplastic polymer.

In one aspect, there is provided a method for soldering a first non-metallic component to one or more metallic or non-metallic components, the method comprising: removably securing the first non-metallic component to the one or more metallic component by using a conductive polymeric composite; or removably securing the first non-metallic component to the one or more non-metallic component by using the conductive polymeric composite, wherein the conductive polymeric composite used in the method comprises a blend of carbon black and polypropylene.

This method may also comprise the step of joining the respective ends of electronic components together using the conductive polymeric composite.

Advantageously, the above method circumvents the need for additional additives, harmful organic solvents or additional time and elevated temperatures. This method can also be used to form, improve or repair electrical connections between components.

Advantageously, the method relies on a conductive polymeric composite which may have high conductivities to sustain a voltage across the soldering points. Conversely, the conductive polymer composite may have low resistivities, such as in the range of about 10^{-3} Ωm to about 10 Ωm. The resistivity of the conductive polymer composite may be dependent or independent of the amount of conductive filler present in the composite.

Advantageously, due to the presence of the thermoplastic polymer in the conductive polymeric composite, the thermoplastic polymer can be re-flowed after the solder has been set. The ability to reflow solder is highly advantageous for changing components in circuitry and for repairing a

An exemplary conductive polymer composite may be made up of polypropylene pellet with carbon black as the non-metallic conductive filler.

The conductive polymer composite may be used with standard soldering tips using optimal soldering temperature of 165ºC to 185ºC or can be used with extrusion pens with hot-end temperatures of 220ºC to 230ºC.

The conductive polymer composite may be compatible with standard electrical components (such as resistors, capacitors, LEDs, thermistors, transistors, etc.) and may be used for soldering or desoldering with a standard soldering tip or hot-end.

The soldering method may be used to repair broken connections in a circuit, may be used to enhance contact between printed layers of exposed wires or to solder circuit components to printed circuits.

~~In another aspect, t~~There is also provided the use of a conductive polymer composite for soldering a first non-metallic component to one or more metallic or non-metallic component, wherein the conductive polymer composite comprises a blend of a filler material and a thermoplastic polymer as defined above. Such a use also possesses the abovementioned advantages.

In another aspect, there is provided a method of using a conductive polymer composite for soldering a first non-metallic component to one or more metallic or non-metallic component, wherein the conductive polymer composite comprises a blend of carbon black and polypropylene.

Definitions

The following words and terms used herein shall have the meaning indicated:

The term “conductive” refers to an object or material that allows or facilitates the flow of electron.

The phrases “removably securing”, “removably forming”, “removably joining” etc. mean that the securing, forming, joining or other actions may result in an electrical connection, joint or formation which can still be altered or removed subsequently. If the connection is not to be altered or removed, the connection can be regarded as a permanent connection. The removal may be performed with or without the aid of additional devices or conditions. The conditions may include increased or reduced temperatures, additional solvents etc.

The expressions “non-metal”, “non-metallic” or other variants refer to any material that does not contain metal. Conversely, the phrases “metal”, “metallic”, “metalloids” or other variants refer to any material that is capable of conducting electricity.

The phrases “electrical” or “electronic” refer to any element that is capable of conducting electricity and/or having an electrical functionality. For instance, an electrical wire serves to connect to electrical parts together and conducts electricity between these two electrical parts via itself. In another example, a light emitting diode may emit light (electrical

functionality) when electricity passes through it. In a further example, a resistor is an electronic device that can be connected to an electrical circuit used to create a potential difference across a portion of the circuit (electrical functionality).

As used herein, the term "alkyl group" includes within its meaning monovalent (“alkyl”) and divalent (“alkylene”) straight chain or branched chain saturated aliphatic groups having

Claims

1. A method for soldering a first non-metallic component to one or more metallic or non-metallic components, the method comprising: ~~the step of~~

removably securing the first non-metallic component to the one or more metallic component by using a conductive polymeric composite; or

removably securing the first non-metallic component to the one or more non-metallic component by using the conductive polymeric composite,

wherein the conductive polymeric composite used in the method comprises a blend of carbon black and polypropylene~~at least one filler material and at least one thermoplastic polymer~~.

2. The method of claim 1, wherein the one or more metallic or non-metallic component is present on a porous or non-porous substrate.

3. The method of claim 2, wherein the porous or non-porous substrate is selected from the group consisting of plastic, glass~~, any flexible material~~ and their combinations thereof.

4. The method of claim 1, wherein the one or more metallic or non-metallic component is a thermally sensitive assembly or component capable of being soldered by the conductive polymeric composite.

~~5. The method of claim 1, wherein the at least one filler material is blended as a continuous or dispersed phase with the thermoplastic polymer.~~

~~6. The method of claim 5, wherein the at least one filler material is a conductive filler material.~~

~~7. The method of claim 6, wherein the conductive filler material is selected from the group consisting of non-metal, metal, alloys, metal-coated carbon based materials and their combinations thereof.~~

~~8. The method of claim 7, wherein the non-metallic filler material is selected from the group consisting of carbon black, carbon fiber, nanofiber, single-walled carbon nanotubes, multi-walled carbon nanotubes, graphene, graphite and their combinations thereof.~~

~~9. The method of claim 7, wherein the metallic filler material is selected from the group consisting of gold, platinum, nickel, cobalt, silver and their combinations thereof.~~

~~10. The method of claim 7, wherein the metal-coated carbon based filler material is selected from the group consisting of metal-coated carbon black, metal-coated graphite, metal-coated carbon nanotubes and their combinations thereof.~~

~~11. The method of claim 10, wherein the metal coating is selected from the group consisting of nickel, cobalt, iron and their combinations thereof.~~

~~12~~5. The method of claim 1, wherein the carbon black ~~at least one filler material~~ is ~~about~~ 20% to 40% weight percent based on the weight of the conductive polymeric composite.

~~13~~6. The method of claim ~~12~~5, wherein the carbon black ~~at least one filler material~~ is ~~about~~ 25% to 35% weight percent based on the weight of the conductive polymeric composite.

~~14. The method of claim 1, wherein the at least one thermoplastic polymer is derived from at least one monomer selected from the group consisting of acrylates, phthalamides, acrylonitriles, cellulosics, styrenes, alkyl, alkyl methacrylates, alkenes, halogenated alkenes, carboxylic acids, amides, imides, aryletherketones, butadienes, ketones, esters, acetals, hydroxyalkanoates, urethanes, dialkylsiloxanes, carbonates and their optionally substituted forms thereof.~~

~~15. The method of claim 14, wherein the at least one monomer is selected from the group consisting of methyls, ethylenes, propylenes, methyl methacrylates, methylpentenes, vinylidene, vinylidene chloride, etherimides, ethylenechlorinates, urethanes, ethylene vinyl alcohols, fluoroplastics, carbonates, styrenes, acrylonitrile butadiene styrenes, etheretherketones, ionomers, butylenes, phenylene oxides, sulphones, ethersulphones, phenylene sulphides, ethylene terephthalate, naphthalene terephthalate, ethylene naphthalene and their combinations thereof.~~

~~16. The method of claim 1, wherein the thermoplastic polymer is selected from the group consisting of polypropylene, acrylonitrile butadiene styrene, polylactic acid, polyethersulphone, polyoxymethylene, polycaprolactone, polyhydroxylbutyrate, polydimethylsiloxanes and maleimide acrylic preimidized polyimide.~~

~~17. The method of claim 1, wherein the conductive polymeric composite is a blend of carbon black and polypropylene.~~

~~18~~7. The method of claim 1, wherein the removably securing step occurs at a temperature of 165ºC to 185ºC when a soldering tip is used or a temperature of 220ºC to 230ºC when an extrusion pen with hot ends is used.

~~19~~8. A method of using ~~Use of~~ a conductive polymer composite for soldering a first non-metallic component to one or more metallic or non-metallic component, wherein the conductive polymer composite comprises a blend of ~~a filler material~~ carbon black and ~~a thermoplastic polymer according to any one of claims 5 to 17~~polypropylene.

~~20~~9. The ~~use~~ method of claim ~~19~~8, wherein the conductive polymeric composite is capable of forming, repairing or enhancing electrical connections between one or more electronic component, wherein the electrical connections are removably formed between a metallic electronic component and a non-metallic electronic component or between two or more non-metallic electronic component.