portions of the substrate can be obtained through this conductive layer. The conductive layer comprises a conductive surface, and there is a patterned layer on at least a portion of a first region of the conductive surface. The patterned layer comprises a conductive material having a surface roughness, and is in electrical contact with the conductive surface. An overcoat layer is present on at least a portion of the first region, such that the overcoat layer has an average thickness less than the surface roughness, such that the conductive layer within the first region is covered by the overcoat layer, and such that at least a portion of the patterned layer substantially protrudes above the overcoat layer. The protrusion allows electrical contact with the patterned layer, and via the conductive layer to other parts of the patterned layer or to connectors to external devices.

[0010] Thus, in one aspect, the present disclosure provides a composite article having a conductive nanowire layer on at least a portion of a flexible substrate, wherein the conductive nanowire layer comprises a conductive surface; a patterned layer comprising metal particles on at least a portion of a first region of the conductive surface, wherein the patterned layer comprises a conductive material having a surface roughness; an overcoat layer on at least a portion of the first region, wherein the overcoat layer has a thickness less than the surface roughness, such that the conductive nanowire layer within the first region is covered by the overcoat layer, and such that at least a portion of the patterned layer substantially protrudes above the overcoat layer.

[0011] In another aspect, the present disclosure provides a touch screen display comprising: a liquid crystal display having first and second opposed major surfaces; a composite article of the types just described overlaying at least one major surface of the liquid crystal display, and a flexible transparent surface overlying the composite article. It should be noted that the flexible transparent surface need not be immediately adjacent to the composite article, and there may be intervening layers imparting other functionalities intervening.

[0012] In another aspect, the present disclosure provides a method of forming a composite article, comprising: forming a conductive nanowire layer on at least a portion of a flexible substrate, wherein the conductive nanowire layer comprises a conductive surface; forming a patterned layer comprising metal particles on at least a portion of a first region of the conductive surface, wherein the patterned layer comprises a conductive material having a surface roughness; and forming an overcoat layer on at least a portion of the first region, wherein the overcoat layer has a thickness less than the surface roughness, such that the conductive nanowire layer within the first region is covered by the overcoat layer, and such that at least a portion of the patterned layer substantially protrudes above the overcoat layer.

[0012a] There is also disclosed a composite film made according to the method as described.

CLAIMS:

1. A composite article, comprising:

a conductive nanowire layer on at least a portion of a flexible substrate, wherein the conductive nanowire layer comprises a conductive surface;

a patterned layer comprising metal particles on at least a portion of a first region of the conductive surface, wherein the patterned layer comprises a conductive material having a surface roughness; and

an overcoat layer on at least a portion of the first region, wherein the overcoat layer has a thickness less than the surface roughness, such that the conductive nanowire layer within the first region is covered by the overcoat layer, and such that at least a portion of the patterned layer substantially protrudes above the overcoat layer.

2. The composite article according to claim 1, wherein the surface roughness is from 0.5 micrometer (μm) to 10 μm

3. The composite article according to claim 2, wherein the surface roughness is from about 2 μm to about 8 μm.

4. The composite article according to claim 2, wherein the surface roughness is from about 3 μm to about 6 μm.

5. The composite article according to claim 1, wherein the overcoat layer is a hardcoat formed from one or more monomer including at least one monomer with multiple (meth)acrylate moieties.

6. The composite article according to any of claims 1 to 5, wherein the flexible substrate comprises an optical element, optionally wherein the optical element is a polarizing beam splitter.

7. The composite article according to any of claims 1 to 6, wherein the metal particles are from 3 μm to 10 μm in diameter.

8. A touch screen display comprising:

a liquid crystal display having first and second opposed major surfaces;

a composite article according to any of claims 1 to 7 overlaying at least one major surface of the liquid crystal display; and

a flexible transparent surface overlying the composite article.

9. A method of forming a composite article, comprising:

forming a conductive nanowire layer on at least a portion of a flexible substrate, wherein the conductive nanowire layer comprises a conductive surface;

forming a patterned layer comprising metal particles on at least a portion of a first region of the conductive surface, wherein the patterned layer comprises a conductive material having a surface roughness; and

forming an overcoat layer on at least a portion of the first region, wherein the overcoat layer has a thickness less than the surface roughness, such that the conductive nanowire layer within the first region is covered by the overcoat layer, and such that at least a portion of the patterned layer substantially protrudes above the overcoat layer.

10. The method of any claim 9, wherein the flexible substrate comprises an optical element, optionally wherein the optical element is a polarizing beam splitter.

11. The method of claim 10, wherein the overcoat layer is a hardcoat formed from one or more monomer including at least one monomer with multiple (meth)acrylate moieties.

12. The method of claim 11, further comprising curing the overcoat layer.

13. The method of claim 12, wherein curing the overcoat layer comprises exposing the overcoat layer to heat or a source of actinic radiation.

14. The method of claim 13, wherein the source of actinic radiation is selected from an ultraviolet radiation source, an infrared radiation source, an electron beam source, or a gamma radiation source.