

Claims

1. A polymer composite, comprising:
 - a) poly(ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS);
 - b) waterborne polyurethane (WPU); and
 - c) a sugar alcohol;wherein the sugar alcohol is selected from the group consisting of glycerol, erythritol, threitol, arabitol, xylitol, ribitol, mannitol, sorbitol, galactitol, fucitol, iditol, inositol, volemitol, isomalt, maltitol, lactitol, maltotriitol, maltotetraitol, polyglycitol, or a combination thereof; and
wherein the sugar alcohol is about 20 wt% to about 50 wt% of the polymer composite.
2. The polymer composite according to claim 1, wherein a ratio of PEDOT to PSS is about 2.5:1 w/w.
3. The polymer composite according to claim 1 or 2, wherein PEDOT:PSS is about 4 wt% to about 25 wt% of the polymer composite.
4. The polymer composite according to any one of claims 1 to 3, wherein WPU is about 37 wt% to 58 wt% of the polymer composite.
5. The polymer composite according to any one of claims 1 to 4, wherein the sugar alcohol is about 38 wt% of the polymer composite.
6. The polymer composite according to any one of claims 1 to 5, the sugar alcohol is D-sorbitol.
7. The polymer composite according to any one of claims 1 to 6, the polymer composite further comprises ethylene glycol at about 0.2 wt% to 1.2 wt% of the polymer composite.

8. The polymer composite according to any one of claims 1 to 7, the polymer composite comprises a homogenous blend of PEDOT:PSS, WPU and sugar alcohol, wherein PEDOT:PSS and WPU each form separate continuous phases in the polymer composite.

9. The polymer composite according to any one of claims 1 to 8, when PEDOT:PSS loading is about 19 wt% of the polymer composite, the polymer composite has an elongation at break is about 35% to about 50%.

10. The polymer composite according to any one of claims 1 to 9, the polymer composite having a conductivity of about 60 S/cm to about 600 S/cm.

11. The polymer composite according to any one of claims 1 to 10, the polymer composite being repeatedly stretchable for at least 400 cycles.

12. The polymer composite according to any one of claims 1 to 11, the polymer composite having a stretchability of more than about 40%.

13. The polymer composite according to any one of claims 1 to 12, the polymer composite having an adhesion force to a skin of about 0.35 N/cm to about 0.7 N/cm.

14. The polymer composite according to any one of claims 1 to 13, the polymer composite having an adhesion force to a glass surface of about 1 N/cm to about 2 N/cm.

15. A polymer composite comprising:

- a) poly(ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) at a ratio of about 2.5:1 w/w;
- b) waterborne polyurethane (WPU); and
- c) D-sorbitol;

wherein (PEDOT:PSS) is about 4 wt% to about 25 wt% of polymer composite; and

wherein the sugar alcohol is about 20 wt% to about 50 wt% of the polymer composite.

16. An electrical device comprising a polymer composite according to any one of claims 1 to 15.

17. The electrical device according to claim 16, having an electrode-skin electrical impedances at 10 Hz of about $70 \text{ K}\Omega \text{ cm}^2$ to about $100 \text{ K}\Omega \text{ cm}^2$.

18. The electrical device according to claim 16 or 17 for generating an electrocardiogram (ECG) signal, wherein an ECG peak-to-peak voltage is about 1.6 mV to about 2 mV.

19. The electrical device according to claim 16 or 17 for generating an electromyogram (EMG) signal, wherein a peak-to-peak amplitude is linearly correlated to an applied force, and wherein a signal intensity is linearly correlated to the applied force.

20. The electrical device according to claim 16 or 17 for generating an electroencephalogram (EEG) signal, wherein the EEG signal perturbable by stimulating an optic nerve of a subject and/or an auditory stimuli.

21. A method of preparing or fabricating a polymer composite, comprises:

- a) mixing PEDOT:PSS with a sugar alcohol to form a first mixture;
- b) mixing the first mixture with WPU to form a second mixture; and
- c) curing the second mixture in order to form the polymer composite;

wherein the sugar alcohol is selected from the group consisting of glycerol, erythritol, threitol, arabitol, xylitol, ribitol, mannitol, sorbitol, galactitol, fucitol, iditol, inositol, volemitol, isomalt, maltitol, lactitol, maltotriitol, maltotetraitol, polyglycitol, or a combination thereof; and

wherein the sugar alcohol is about 20 wt% to about 50 wt% of the polymer composite.