Smart and Robust Nanocomposite Fibers for Self-Powering Electronic Devices

Al-Janahi, Abdullah (School: Qatar Science and Technology Secondary School for Boys)
Al-Nasr, Abdullah (School: Qatar Science and Technology Secondary School for Boys)

Consumption of non-renewable sources of energy for powering electronic devices is a common practice, causing the depletion of fossil fuels. The current project aims at the development of a polymeric nanocomposite material capable of generating electric voltage when mechanical forces are applied to it. The polymer nanocomposite is synthesized using Polyvinylidene fluoride hexafluoropropylene (PVDF-HFP) and a hybrid combination of nanoparticles –iron oxide (FeO) and titanium dioxide (TiO2) by electrospinning technology. While ultrasonication process helps in the uniform distribution of nanomaterials, electrospinning ensures structural integrity. The polymer nanocomposite fibers are silver electroded on both sides to form an electronic circuit for investigating the piezoelectric power generation. The research investigated the flexibility, mechanical robustness, efficient energy storage performance of the developed material. Better electroactive phase formation is noticed in the hybrid nanocomposite, due to the influence of nanomaterials in enhancing the polymeric dipole alignment and thus the piezoelectric property. Nanomaterials influence the crystalline behavior of the polymer in terms of glass transition and melting temperatures, as revealed by the differential scanning calorimetric study. Dielectric studies indicated the energy storage capability of the material as correlated with the output voltage generation. High dielectric constant and the piezoelectric output voltage of 3 V obtained for the PVDF-HFP hybrid nanocomposite fibers illustrate the technical feasibility of the proposed material. We strongly believe that the current product will be able to self-power electronic devices and can be useful for flexible and wearable electronic applications.

Awards Won: