Seminar

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Institute for Plasma Research

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Title: Development of Polymer Nanocomposites as Self-powered Sensors, Optoelectronics, and Flexible Energy Harvester and Storage

Speaker: Dr. Ipsita Chinya
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Date: 21st February 2025 (Friday)

Time: 03:30 PM

Venue: Online- https://meet.google.com/vaq-uerx-dco

Abstract

Harvesting small-scale mechanical energy to obtain electricity is one of the most promising technologies to meet the rapid worldwide energy depletions and fulfill the miniaturization of wearable electronics and flexible sensors. Polyvinylidene fluoride (PVDF) and its copolymers, in their extended β-electroactive phase, are the most promising contender for flexible energy harvester applications owing to their high energy conversion efficiency with low fatigue failure. Among the various techniques to attain thermodynamically control all-trans polar β-PVDF from its nonpolar α-phase, the incorporation of nanofillers is designated as the most cost-effective, industrial-friendly technique. Here, nanofiller acts as a heterogeneous nucleating agent and the surface charge of filler helps in the reorientation of PVDF macromolecular structure employing ion-dipole interaction, and thus superior piezo-electricity without any secondary processing can be obtained. The effect size, morphology, shape of the filler play a crucial role in polar phase formation and along with its surface compatibility with the polymer. Also depending on the dimensionality of fillers (0D/1D/2D/3D) a wide range of applications can be considered. Tuned structured fillers are superior for better all-trans alignment of the polymer chain. Additionally, the polar phase percent could also be enhanced if the size of the filler is nearly equal to the radius of the gyration of the polymer chain. On the other hand, 0D fillers such as quantum dots are excellent for fluorescence and photoluminescence applications. Additionally, 2D fillers are used to make the composite ready for optoelectronics applications. The effect of filler incorporation will be analysed with respective plausible mechanisms and theoretical simulation. Finally, some applications such as capacitor charging, illuminating LEDs, monitoring height/ motions, voice recognition, airflow scavenger, self-powered sensors, electronics, etc. were explored for optimized composite systems. A multifunctional prototype will also be designed and demonstrated for self-powered optoelectronics and fluorometric probe applications.

Keywords: PVDF and its co-polymer; Nanogenerator; Self-powered electronics, renewable energy harvester, sustainable material