

A NEW-FANGLED FLEXIBLE NANOGENERATOR COMPRISING OF POLY (VINYLIDENE FLUORIDE) (PVDF)/ POTASSIUM SODIUM NIOBATE NANORODS (KNN-NRS) BASED NANOCOMPOSITE FILM

Bairagi S., Ali S.W.

Department of Textile Technology, Indian Institute of Technology, Delhi, New Delhi, India
ranjansatyabairagi@gmail.com

ABSTRACT

In the recent days, Potassium Sodium Niobate (KNN) has drawn a great interest in piezoelectric applications because of their lucrative piezoelectric properties such as higher piezoelectric coefficient ($d_{33} \sim 420$ pC/N), larger value of dielectric constant ($\epsilon \sim 290$) and higher electromechanical coupling factor ($K_{33} \sim 0.64$). In addition, KNN is lead free unlike Lead Zirconium Titanate (PZT) which contains more than 60% lead. Here we report the development of non-poled KNN nanorods (NRs) @ PVDF composite film based flexible nanogenerator. To achieve the goal, firstly, KNN NRs have been synthesized in our lab with process optimization and thereafter nanocomposite films have been prepared by solution cast method. As prepared films have been characterized by XRD and FTIR spectroscopy for structural analysis and SEM for morphological analysis. FTIR results have revealed that 10% KNN NRs @ PVDF composite film possesses the highest electroactive (β crystal) crystal phase ($\sim 98\%$). The reasons are the nucleating effect and uniform distribution of KNN NRs throughout the PVDF matrix which has also been reaffirmed by XRD results. The dielectric constant (ϵ) value (~ 23) and the energy density (0.053 J/cm³ at an electric field of 164 kV/cm) are also high in the case of 10% KNN NRs @ PVDF composite film. The KNN NRs incorporated non-poled nanocomposite based nanogenerator (10% KNN NRs @ PVDF composite film) is competent to generate open circuit voltage and output current up to 3.4 V and 0.100 μ A (10 M Ω resistance has been connected across the nanogenerator) by respective repeated compressive force on it, whereas current density generated by this generator was 0.025 μ A/cm². It is the first time that the PVDF/ KNN NRs nanocomposite based flexible nanogenerator has successfully been demonstrated by us. The performance of our nanogenerator will surely open up a new root to use it as a lead-free polymer/ NRs based flexible piezoelectric energy harvester with low level of filler loading.