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PERFORMANCEOFA SELF-POLED HYDRATED SALT ASSISTED SPONGE LIKE PIEZOELECTRIC GENERATOR: AN EFFECTIVE MECHANICAL ENERGY HARVESTER

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ABSTRACT

Polymers with high electro-mechanical response are attractive for a broad range of applications, *e.g.*, actuators, transducers, micro-electromechanical systems, robotics and biomedical sensors due to their light weight, flexibility and ability to form into intricate shapes. Among the known polymers, Poly(vinylidene fluoride) (PVDF) and its copolymers are the best known piezo-polymers those exhibiting the highest piezoelectric responses. P(VDF-HFP), a copolymer of PVDF, gained similar type of applications due to its large strain in response to electric field because it exhibit an unusual piezoelectric response, *i.e.*, $|d_{31}/d_{33}|>1$, which is different compared with other piezoelectric class of polymers. In this work, we have prepared hydrated salt filler assisted sponge like P(VDF-HFP) micro-porous electro-active films to fabricate an effective means of flexible piezoelectric generator (FPG) which demonstrated an open circuit voltage of about 8V and generated enough power to instantly turn on several (more than 15) commercial blue light emitting diodes (LEDs). In addition, it successfully charged up capacitors by simple repeating finger touch motion. This indicates its potential for an energy harvesting power source, where different kind of mechanical vibrations can be applied.

Keywords: Self-poled, Sponge like P(VDF-HFP) film, β-phase, Piezoelectric energy harvester.

INTRODUCTION

Among the known polymers Poly(vinylidene fluoride) (PVDF) and its co-polymer Poly(vinylidene fluoride-trifluoroethylene) [P(VDF-TrFE)] have large applications due to their permanent electro-active β-pase (all-trans conformation (TTTT)) that exhibit excellent ferroelectric, piezoelectric and pyroelectric properties. However due to their higher price and low Curie transition temperature (Tc) of P(VDF-TrFE) limits its device operating temperature and industrial applications. P(VDF-HFP), one of the other copolymer of PVDF, have been paid special attentions due to its large strain in response to electric field because it exhibit an unusual piezoelectric response, *i.e.*, $|d_{31}/d_{33}|>1$, which is different in comparatively other polymers [1].

In this work, the special importance was made on introducing the electroactive β- and γ-phases in P(VDF-HFP) by utilizing hydrated metal salt filler (*i.e.*, $MgCl_2.6H_2O$) [2]. We are also able to achieve large proportion (99%) of the electroactive phases in combination with electrets like micro-pores in P(VDF-HFP) films, which is suitable for versatile (flexible piezo-, pyro- and ferroelectricity based) device fabrication. The energy harvester made by sponge like Mg-salt assisted P(VDF-HFP) film deliver up to 8 V of open circuit voltage under external pressure and also generate enough power to turn on at least fifteen commercial blue light emitting diodes (LEDs) instantly due to co-operative performance of porous electret structure and electroactive nature of Mg-salt utilized films without the electrical poling.