Performance of SiC-doped 3D printed PLA for triboelectric energy harvesting

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Based on contact electrification and electrostatic induction between two surfaces that are in relative motion for converting mechanical energy to electrical energy, TENGs are emerging as one of the most promising power sources for autonomous electronics and sensors. Although several technologies have been proposed in the literature for the fabrication of TENGs, 3D printing technologies are expected to promote the rapid development and widespread application for the next-generation portable electronics and Internet-of-Things applications [1]. In this work we investigate the performance of SiC-doped 3D printed PLA in triboelectric applications.

A series of specimens was produced by first extruding filaments of PLA containing 1-3% SiC (average size 15μm) and then using them to 3D-print discs of diameter 32mm and thicknesses 0.3mm and 9mm. The samples were subsequently polished using grinding papers of various grit sizes, resulting in samples of different surface roughness.

Electrical characterization of the samples was performed in contact-separation mode using Kapton® as a reference electrode (Fig. 1a). The output of the triboelectric generator was monitored as a function of time, in conjunction with respective charging of a 0.47 uF capacitor (Fig. 1b).

The results indicate that for the 2% SiC doped PLA the capacitor voltage reaches much higher values compared to the other samples which can be explained if we assume an increase of surface charge density. Simulation studies were also performed using COMSOL showing a good agreement between simulated and experimental results for the undoped PLA and the 2%SiC doped PLA, if we assume that the surface charge for the latter case increases by 50% compared the other samples.

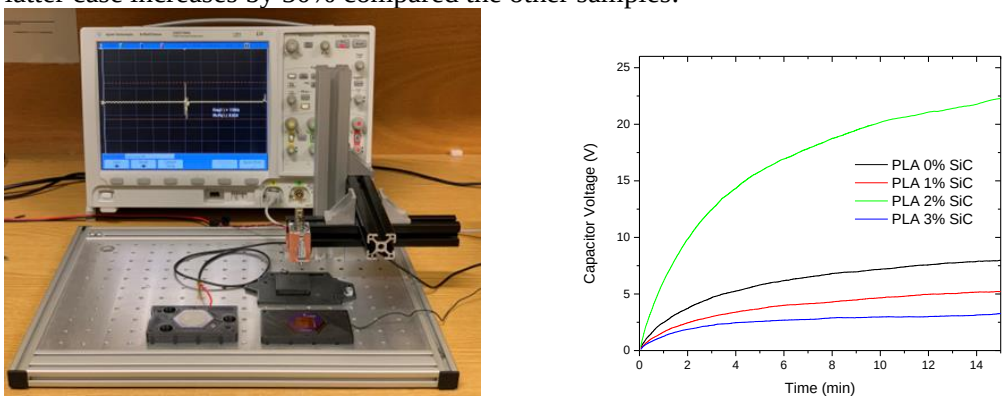

Figure 1 a) Experimental setup for contact-separation mode measurements and b) Capacitor voltage as a function of time for the PLA discs with different concentrations.

References

[1] B. Chen et al, Materials Today, Vol 50 (2021), Pages 224-238

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