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Poly (vinylidene fluoride) based percolative dielectrics with tunable coating of polydopamine on carbon nanotubes: toward high permittivity and low dielectric loss

Jiaming Zhu, Xiaoying Ji, Min Yin, Shaoyun Guo, Jiabin Shen*

State Key Laboratory of Polymer Materials Engineering, Polymer Research Institute of Sichuan University, Chengdu 610065, P. R. China

ABSTRACT

Polydopamine (PDA) coated carbon nanotube (CNT)/poly (vinylidene fluoride) (PVDF) dielectric composites were fabricated through self-polymerization of dopamine hydrochloride (DAH) monomers. Microscopic observation substantiated that the thickness of PDA coatings on CNTs was tunable by varying the DAH/CNT ratios. When the PDA@CNTs were incorporated into the PVDF matrix, the electrical resistivity of the PDA@CNT/PVDF increased up with the thickening of PDA coatings, due to the inhibition of the direct contact between adjacent conductive particles. Considering the negative influence of current leakage on dielectric loss, the contribution of PDA coatings on dielectric behaviors of CNT/PVDF systems was compared at a similar resistivity. The results exhibited that accompanied with the enrichment of PDA contents, a more competitive balance between permittivity and loss factor was achieved. As an example, when 0.1wt% 0.03PDA@CNTs were replaced by 0.2wt% 0.2PDA@CNTs, the permittivity at 10^3 Hz was increased from 154 to 315 and the loss factor was reduced from 0.92 to 0.35. This indicated that the dielectric loss induced by the current leakage was suppressed when the conductive particles were coated by PDA layers. Accordingly, it can be regarded as one of strategies to make the percolative systems achieve high permittivity and low dielectric loss.

* Corresponding authors. Tel/Tax: 86-28-85466077. Email: shenjb@scu.edu.cn