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Bio-inspired polydopamine-assisted graphene oxide coating on tetra-pod zinc oxide whisker for dielectric composites

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ABSTRACT: Polymeric dielectric composites have wide applications in many fields ranging from wearable devices, sensors to energy storage. In this work, a novel kind of hybrid particles with 'core-shell'-like structure were fabricated via the polydopamine-assisted deposition technology, in which the tetra-pod zinc oxide whisker (T-ZnOw) was the 'core' and the two-dimensional graphene oxide (GO) was the 'shell', while polydopamine (PDA) was the adhesion layer between T-ZnOw and GO. With the aid of PDA adhesion layer, the 'core-shell'-like structure of the hybrid GO/PDA@T-ZnOw particles could be maintained in the poly(vinylidene fluoride) (PVDF) composites. Dielectric property measurements showed that the hybrid particles could be an excellent candidate to prepare the dielectric composites with excellent dielectric properties. There was a critical particle content (2.0-2.5 wt%) at which the composites exhibited the maximum dielectric constant and relatively low dielectric loss. Further results showed that GO and PDA@T-ZnOw particles had tremendous synergistic effect in enhancing the dielectric properties of the composites. The mechanisms for the largely enhanced dielectric constant were mainly related to the multiple interfaces in the composites, including the interfaces between GO and PVDF, between GO and PDA and between PDA and T-ZnOw, which provided more probability for interfacial polarization of the composites in the electrical field. This work presents a guideline to design high-performance dielectric composites with construction of the multiple interfaces.

Keywords: PVDF dielectric composites; tetra-pod zinc oxide whisker; graphene oxide; polydopamine adhesion layer; multiple interfaces

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