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Poly(vinylidene fluoride)-Based Composites Modulated Via Multiscale Two-Dimensional Fillers For High Dielectric Performances

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Abstract: Ultrathin two-dimensional (2D) semiconductor molybdenum disulfide (MoS_2) nanosheets have wide applications in electronic devices. Incorporation of MoS_2 nanosheets into poly(vinylidene fluoride) (PVDF) renders a type of dielectric composite regulated with 2D architecture. However, due to the semiconducting behavior of MoS_2, the accompanying high dielectric loss prevents the composite being good dielectrics. Aluminum flakes (AFs), another 2D structure in micron scale, were thus introduced into the MoS_2/PVDF composite to block leakage path as well as providing another source for electric polarization. The effects of multiscale 2D fillers on adjusting the dielectric and electrical properties of the ternary MoS_2/AFs/PVDF composites were investigated systematically. The largely suppressed dielectric loss and electrical conductivity of ternary composite compared with those of MoS_2/PVDF composite is ascribed to the parallel arranged self-passivated AFs, which effectively inhibit the direct connection and overlapping of MoS_2 nanosheets along the electric field direction. Meanwhile, formation of numerous micro-capacitors with AFs as electrodes and MoS_2/PVDF composite as dielectric medium makes an additional