Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C

An Aluminum Nanoparticle-Acrylate Copolymer Nanocomposite for Dielectric Elastomer with a High Dielectric Constant

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Fig. S1 is the FT-IR spectrum of surface-modified Al nanoparticles. The peaks at 1720 cm^{-1}, 1635 cm^{-1} and 1457 cm^{-1} are respectively attributed to C=O stretching vibration, C=C stretching vibration and H-C-H scissor bending vibration, all from the ligand.

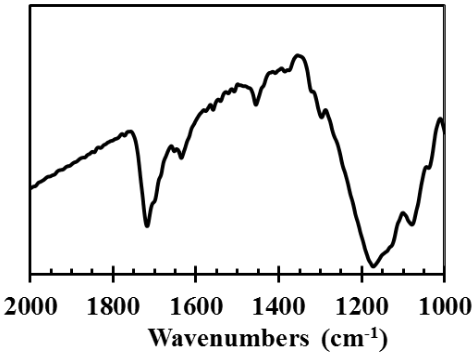

Fig. S1. FT-IR of surface-modified Al nanoparticle.

To verify the dispersion of the Al nanoparticles, the nanoparticles were dispersed in n-butyl acrylate at a concentration of 5 mg/ml. The dispersions were ultrasonicated for 5 minutes and poured onto distilled water. Photographs were immediately taken and shown in **Fig. S2** (a) for as-received nanoparticles without surface modification and in **Fig. S2** (c) for those with surface modified. Photographs were also taken after 30 minutes to allow any large-size aggregates of nanoparticles to settle. The Al nanoparticles without surface modification settled down to the bottom of the vial (**Fig. S2** (b)), while the surface-modified nanoparticles remained dispersed in the n-butyl acrylate layer (**Fig. S2** (d)).

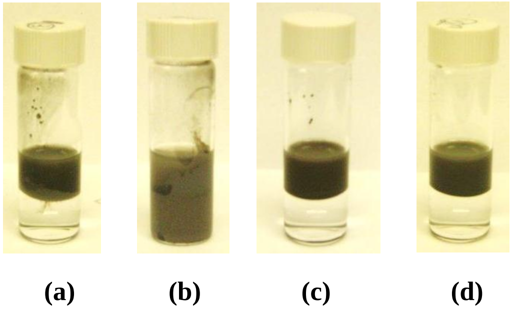

Fig. S2 Photographs of Al nanoparticle dispersion in n-butyl acrylate phase separated from water (lower layer). Nanoparticles in (a) and (b) were dispersed without surface modification, and in (c) and (d) with surface modification. Photographs were taken immediately after dispersion was made by ultrasonication and ((a) and (c)), and 30 min later ((b) and (d)).

The stability of Al nanoparticle in air was studied by thermogravimetric analysis (TGA). Both the as-received Al nanoparticles and surface modified nanoparticles were heated in air at 80 ^{O}C, which is the curing temperature of the nanocomposites, for one hour. No mass increase was observed during the heating, indicating that oxidation on the nanoparticle surface (which already has a 2.8 nm thick oxide passivation layer) is negligible. (**Fig. S3**)

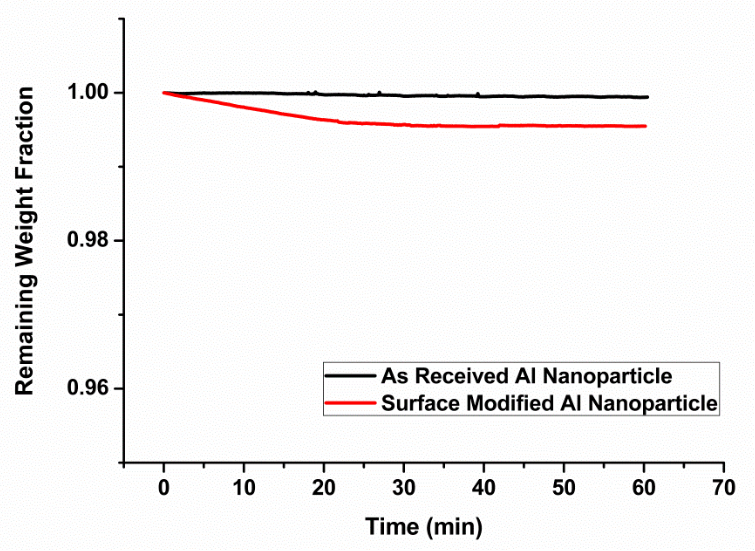

Fig. S3 TGA of as received Al nanoparticles and surface modified Al nanoparticles during at 80 ^{O}C in air atmosphere.