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Electric field assisted gradient structure formation of glass microsphere columns in polymer films

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Abstract: Electric field-driven fabrication of gradient particle/polymer film was presented in current work. Direct-current (DC) field drives hollow glass microspheres (HGMs) to form microcolumns in UV-curable resin NOA65 by electrophoresis force and subsequently cured. In this field assisted alignment process, the microcolumns also exhibit gradient structure. The real-time organization of HGMs in the NOA65 was monitored during DC application by measuring the light transmission and taking photos with visible spectrometers and optical microscope respectively as the formation of column formation creates depletion zones between the columns leading to higher light transmission. The morphology evolved was found to depend on the electric field strength used and exposure time. The mechanical properties of the films produced by this process exhibit unique anisotropies when tested parallel and perpendicular to the electric field. When 10 phr HGMs in NOA65 undergoes 1000V/mm of DC for 0, 2, 4, 8 min respectively, the film obtained at 8 min shows highest storage modulus while the film obtained at 4 min shows highest modulus in