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Thermally induced infiltration of polymer into nanoparticle packings JYO LYN HOR, University of Pennsylvania, Department of Chemical and Biomolecular Engineering, YIJIE JIANG, KEVIN T. TURNER, University of Pennsylvania, Department of Mechanical Engineering and Applied Mechanics, DAEYEON LEE, University of Pennsylvania, Department of Chemical and Biomolecular Engineering — We present a novel approach in generating three-phase polymer nanocomposites via capillary rise infiltration (CaRI) of polymer into a dense nanoparticle packing, which we have previously utilized to generate dense nanocomposites with extremely high filler fraction. The CaRI process involves first generating a bilayer film of porous nanoparticle layer on a polymer layer, followed by annealing of the bilayer above the Tg of the polymer to induce polymer infiltration into the voids of the nanoparticle layer. By tuning the amount of polymer to be less than the void volume of the nanoparticle layer, we demonstrate that CaRI is capable of generating spatially homogeneous porous composite. We utilize spectroscopic ellipsometry to characterize and monitor the polystyrene infiltration process into the titania nanoparticle packing in-situ. The infiltration process occurs in two stages. Upon annealing, we observe that the polymer layer is depleted rapidly via capillary-induced infiltration to form a dense composite at the base of the nanoparticle packing. Eventually, the front of this composite layer propagates throughout the nanoparticle packing, just as the composite refractive index decreases, indicating the redistribution of polymer throughout the nanoparticle matrix.

Jyo Lyn Hor
University of Pennsylvania, Department of Chemical and Biomolecular Engineering

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