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Self-assembly of nanoparticles in evaporating particle-laden emulsion drops MIN PACK, XIN YANG, YING SUN, Drexel University — In this study, we demonstrate the scalable fabrication of nanostructures (e.g., nanomesh and nanoring arrays) via inkjet printing of oil-in-water emulsion drops containing nanoparticles in water. Nanoscale oil drops dispersed in water are used here as templates for assembly of nanoparticles on a substrate. The effect of oil vapor pressure on particle deposition morphologies is studied by using a variety of oils. For oil drops with a lower vapor pressure, non-uniform evaporation rate along the air-water interface drives dispersed oil drops to move and accumulate near the air/water/substrate contact line. These oil drops remain on the substrate while water is evaporating enabling nanoparticles to self-assemble into nanomeshes. While keeping the same oil concentration, oil drops with a higher vapor pressure completely evaporates near the contact line before water dries out, leading to nanoparticle deposition of coffee-ring structures. If nanoparticles are confined inside the dispersed oil drops, nanoring arrays are formed as the emulsion evaporates. The characteristics of the nanomeshes and nanorings are controlled by tuning the size and concentration of oil drops and nanoparticles, substrate wettability, surfactant concentration, and vapor pressure of oil.

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