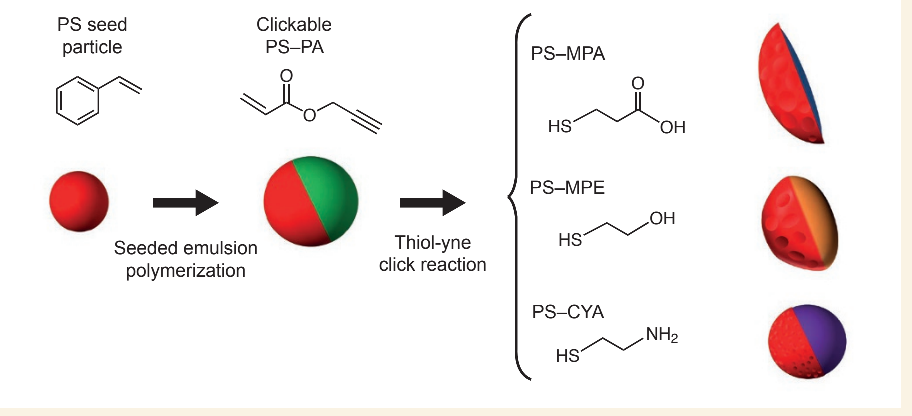
NANOMATERIALS

Two sides to every particle

Emulsions — ubiquitous in foods, pharmaceuticals and cosmetics — are intrinsically unstable because they feature large interfacial areas. Nanoparticles that simultaneously host two or more surface chemistries, better known as 'Janus particles', can possess both hydrophilic and lipophilic components and can stabilize emulsions by strongly adsorbing to fluid–fluid interfaces. Such particles are typically synthesized through surface functionalization of homogenous particles or by inducing phase separation between two incompatible polymers, but the former only produces limited quantities and the latter can only afford particles whose properties are governed by the nature of the polymer precursors. Now, Laura Bradley, Kathleen Stebe and Daeyeon Lee from the University of Pennsylvania have devised a scalable method to obtain Janus particles with variable compositions and morphologies. (*J. Am. Chem. Soc.* **138,** 11437–11440; 2016).



The team use 'seeded emulsion polymerization' to synthesise polystyrene–poly(propargyl acrylate) (PS–PA) particles. The choice of PA monomer is key because its pendant acetylene group provides the opportunity for thiol–yne click chemistry — a tool that can be used to readily make stable carbon–sulfur–carbon bonds. The researchers performed click reactions with various commercially available thiols, specifically 3-mercaptopropionic acid (MPA), 2-mercaptoethanol (MPE) and cysteamine (CYA), thus providing access to Janus particles with diverse chemical properties. Furthermore, varying the particle concentration or the duration of the click reaction enables control over the extent of modification, which in turn influences particle morphology and the type of emulsion that can be stabilized.

Taking it one step further, Lee and colleagues exploit their partially modified particles in secondary click reactions, obtaining materials that have multiple substituents on just one side of the particles. Modifying the interior of surface-only functionalized PS–CYA precursors with MPA produces particles with surface amine groups and internal pH-responsive carboxyl groups. Such Janus particle composites could potentially be useful for catalysis or drug-delivery applications, where the external composition would dictate how the particle interacts with the environment and the internal composition would provide the necessary functionality.

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