Oriented assembly of anisotropic particles by capillary interactions

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We study capillary interactions that drive oriented assembly of anisotropically shaped objects. Capillary interactions between micro- and nano-scale particles drive particle assembly at fluid interfaces. This has been well studied in the context of spherical particles. The particles distort the interface, creating excess surface area. Excess area decreases as particles approach each other, creating attraction. Anisotropically shaped particles create excess areas that are non-uniformly distributed around the particle center of mass. Local regions of concentrated excess area develop that drive oriented assembly. A force balance is used to infer relationships between particle aspect ratio and regions of concentrated excess area that drive orientation and assembly. These arguments are supported in experiment. Short-range capillary interactions have been predicted to promote alignment of particle faces. Based on this concept, particles with complex end faces that align with end-to-end registry are created.