

# Synthesis of Non-spherical Patchy Particles at Fluid-Fluid Interfaces via Differential Deformation and their Self-Assembly

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Non-spherical patchy particles are potential candidates as building blocks for the design of target colloidal structures via spontaneous self-organization. We report a facile scheme to synthesize non-spherical particles with patchy electrostatic interactions. In this method, charged spherical latex particles such as polystyrene (PS) are deformed unequally at an oil-water interface due to heating and partial swelling. The spherical particles then evolve into non-spherical shapes such as acorn and 'idly-like'. We explain the mechanism of differential deformation by comparing the heat of viscous dissipation and the interfacial energies. Further, if oppositely charged additives such as cetyltrimethylammonium bromide (CTAB) surfactant or silica nanoparticles are present in water (subphase), electrostatic attraction leads to adsorption of these species on the PS surface exposed to water. As a result, one side of the particle is selectively functionalized, while the other side remains unaltered. As the latex particles are negatively charged initially, this method yields particles that are non-spherical in shape and with negative charges on one side and positive charges on the other side. The degree of shape deformation and patch coverage can be varied by choosing different surface active additives. We extend this approach to curved interfaces and demonstrate a high throughput emulsion based approach for the synthesis of such particles. Self-assembly of these particles shows interesting structures such as linear, branched polymeric or worm like chains and micelle-like spherical aggregates. These shape anisotropic particles with orientation specific interactions that mimic bio-macromolecular systems can be further explored for self-assembly into hierarchical mesoscale structures.

