A NEW CLASS OF SOFT DENDRITIC COLLOIDAL MICROGELS WITH EXTRAORDINARY GELATION AND ADHESIVE CAPABILITIES

Orlin D. Velev, Chemical and Biomolecular Engineering, North Carolina State University, USA.
odvelev@ncsu.edu
Sangchul Roh, Austin Williams, Rachel Bang, North Carolina State University, USA.
Simeon Stoyanov, Physical Chemistry and Soft Matter, Wageningen University, The Netherlands.

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The interplay between morphology, excluded volume, and adhesivity of colloidal-scale particles critically determines the physical properties of numerous materials such as gels, suspensions, emulsions, foams, and coatings. The structure-building and gel-forming abilities of colloids in liquid can be enhanced by particles with branched and fractal morphology. We will present a new class of soft dendritic colloids ("dendricolloids") that are fabricated by a simple and scalable process of polymer precipitation in turbulently sheared liquid medium. These new soft particles have a hierarchical morphology similar to molecular-scale polymer dendrimers, but two orders of magnitude larger in scale. The polymer microgel-like particle with branched and fractal morphology are formed as a result of the eddy-guided polymer precipitation in turbulently sheared liquid. The ultralow interfacial tension of a polymer solution, combined with concurrent phase separation and precipitation, results in the formation of hierarchical fibrillar polymer microgels. The branched, dendritic particles are surrounded by a corona of polymer nanofibers spreading out in all directions. The dendricolloids combine the properties of two of the most fascinating and studied soft matter systems – the freely-suspended dendritic particles have very large excluded volume, while on contact their nanofiber corona possesses the highly adhesive abilities of the nanofiber-padded gecko legs. We investigate and analyze the origins of these effects, which are closely associated with omnipresent van der Waals forces and the phenomenon of "contact splitting" that allows the legs of the gecko lizards to stick to any surface. The fractal branching and contact splitting phenomena of the polymer dendricolloids enable a range of highly unusual properties – gelation at extremely low volume fractions, strong adhesion to surfaces and to each other, and ability to bind strongly and form coatings, nonwoven sheets, and ultrasoft membranes.

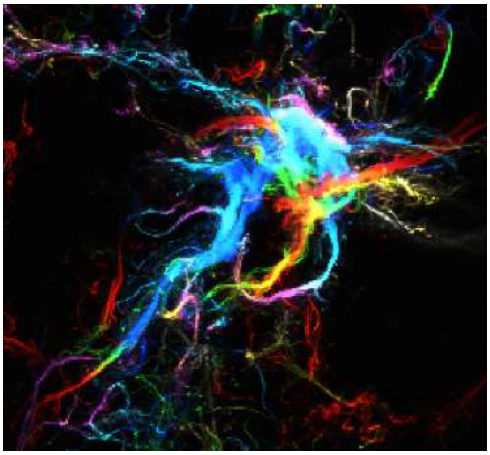

Figure 1 – Confocal reconstruction of the 3D structure of a single dendritic colloid particle made of polystyrene.