Texas Tech University
Department of Chemical Engineering
Seminar Series

Orlin D. Velev

Department of Chemical and Biomolecular Engineering,

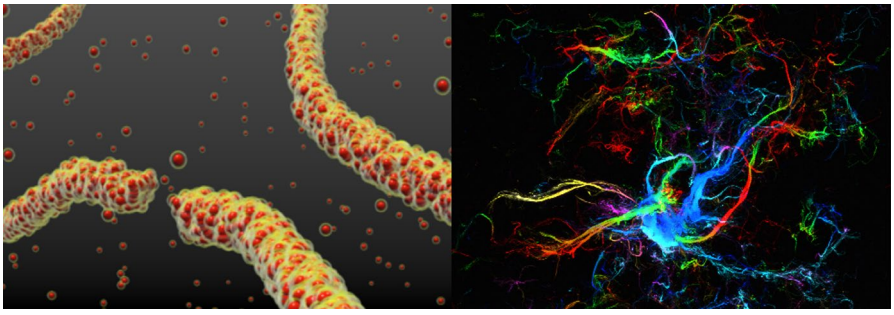
North Carolina State University, Raleigh, NC 27695, USA;

odvelev@ncsu.edu; http://crystal.che.ncsu.edu/

Liquid Nanofabrication of Functional Multiphasic Soft Matter by Capillary Binding and Interfacial Templating

Abstract:

We will present two new engineering strategies which use multiphasic liquid-liquid-polymer systems to make a rich variety of novel colloidal structures and materials. The capillary forces originating at the liquid/liquid interfaces can serve for reconfigurable binding in soft matter systems, including Pickering emulsions, novel responsive capillary gels, and compositions for 3D printing. Alternatively, the liquid/liquid interfaces can also template the formation of a variety of polymer nanomaterials. We will first present responsive structures made of filaments from lipid-coated magnetic nanoparticles suspended in water-oil systems. The nanocapillary binding results in ultra-high filament flexibility. As an example of the application of such structures, we will discuss the development of new 3D printing inks consisting of water, crosslinked PDMS microbeads and liquid PDMS phase. These Homocomposite Thixotropic Pastes (HTPs) can be directly extruded and shaped on a 3D printer. The curing of the PDMS bridges yields remarkably elastic, flexible and biocompatible structures. The HTP-3DP inks enable new opportunities for 3D printing of "active" and magnetically reconfigurable structures. In the second new materials synthesis approach the liquid/liquid droplet interfaces template the formation of a variety of polymer nanomaterials, including nanoparticles, nanofibers, nanoribbons, microrods and microsheets. The interfacial polymer precipitation in turbulently sheared liquid media results in a new class of soft dendritic polymer microparticles ("dendricolloids") with hierarchical morphology similar to molecular-scale polymer dendrimers, but two orders of magnitude larger in scale. The dendricolloids combine the properties of fascinating soft matter systems – the freely-suspended dendritic particles have very large excluded volume, while in contact their nanofiber corona possesses the highly adhesive abilities of the nanofiber-padded gecko legs. Thus, the polymer dendricolloids possess highly unusual properties – gelation at very low volume fractions, strong adhesion to surfaces and to each other, and ability to bind strongly and form coatings, nonwoven sheets, and ultrasoft membranes.



Bio:
Dr. Orlin Velev is a Frank and Doris Culberson Distinguished Professor at NC State University. He received Ph.D. degree from the University of Sofia, Bulgaria (1996), while also working for one year in Japan. Velev accepted a postdoctoral position and later became research assistant professor at the Department of Chemical Engineering, University of Delaware. In 2001 formed his new research group in the Department of Chemical and Biomolecular Engineering, NC State University, where he was promoted to chaired professor in 2009. Velev has contributed more than 210 publications and has presented more than 270 invited presentations. His numerous awards include NSF Career, AIChE Andreas Acrivos Award for Professional Progress and ACS Langmuir Lecturer. Velev has been elected to an ACS Fellow and MRS Fellow. He has established a record of innovative research in the areas of colloids and nanostructures with electrical and photonic functionality, biosensors, microfluidics and nanomanufacturing. Velev has been the first to synthesize "inverse opals" and has pioneered novel nanoparticle materials, Janus and special shape particles, and responsive active materials and microstructures. He has been an advocate of incorporating the latest achievements in the areas of nanoscience and soft matter in the engineering curriculum.

Links (if needed)

Velev faculty page: http://crystal.che.ncsu.edu/

Velev group web-page: https://www.cbe.ncsu.edu/velevgroup/

Friday, March 13th

Livermore 101

3:00 pm