



# MATERIALS SCIENCE and ENGINEERING SEMINAR

Co-sponsored by the Center for Hybrid,  
Active and Responsive Materials (CHARM)



## Dr. Sergei S. Sheiko

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**University of North Carolina at Chapel Hill**

**Bottlebrush Elastomers and Gels: Programming Tissue-mimetic  
Properties by Architecture**

Bottlebrush macromolecules are resourceful building blocks for constructing tissue-mimetic materials with sought after combinations of softness, damping, swelling, and adhesion. Densely grafted side chains define physical properties in two ways: (i) they disentangle network strands and (ii) they increase strand persistent length. The first trait alleviates constraints for lowering the crosslink density, enabling supersoft and super-swelling polymer networks that closely match soft tissues like brain and jellyfish. The second trait, variable persistence length, controls elastic modulus, strain-stiffening, and relaxation times. By architecturally tuning the size and flexibility of brush-like network strands, we can create materials possessing oxymoronic property combinations, such as being soft-yet-firm, elastic-yet-dissipating, and stiff-yet-stretchable. Recently, we have explored brush macromolecules with active backbones that synergize with the passive side chains to generate novel materials such as super swelling-yet-resilient hydrogels and bottlebrush liquid crystals. In short, the design-by-architecture approach empowers programmable variations of a network's modulus, damping factor, swelling ratio, and Rouse time independently of one another, meeting the diverse needs of both medical and non-medical technologies.

**MSEG  
SEMINAR**  
**4/23/2025**

**10:30 a.m.**

**Colburn 366**

**[mseg.udel.edu](http://mseg.udel.edu)**

### BIOGRAPHY

**Sergei Sheiko** received his PhD in Polymer Physics from the Russian Academy of Sciences in 1991. In 2000, Sergei completed his Habilitation in Polymer Chemistry at the University of Ulm in Germany. He started at the University of North Carolina at Chapel Hill in 2001 and received his tenure in 2005. Currently, Sergei Sheiko is a George A. Bush, Jr. Distinguished Professor and a Fellow of the American Physical Society.



**College of Engineering**

DEPARTMENT OF MATERIALS SCIENCE &  
ENGINEERING

CENTER FOR HYBRID, ACTIVE,  
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