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# Load Transfer In Hybrid Organic-Inorganic Materials Across Scales


*Rouzbeh Shahsavari*

*Assistant Professor*

*Civil and Environmental Engineering,*

*Rice University*



**Abstract:** By combining platelet-like ceramic building blocks and organic matrices, nature creates hybrid materials such as bone, teeth and mollusk shells that have outstanding balance of stiffness, strength and flaw-tolerance. This has inspired fabrication of several advanced human-made polymer-matrix composites with inorganic reinforcing materials such as cement, clays, glass, graphite, SiC, and mica. In all these natural and engineered composites, the issue of load transfer in is a delicate, but critical problem that has a significant impact on the overall mechanical performance of the composites. In this talk, first I will discuss the origins of load transfer at the subatomic level on polymer-cement layered nanocomposites, as an example of hybrid materials with geometry and property mismatch across the interface. I will illustrate how the maximum toughness, incorporating both intra- and interlayer strain energy contributions, governs the existence of optimum overlap length and thus the rupture of interfacial H-bond assemblies in natural and synthetic hybrid materials. Second, a generalized theoretical framework will be developed that provides important physical intuitions and quantitative information on mechanisms of interfacial shear load transfer. Finally, I highlight and comment on innovative strategies for tuning the interplay between geometric constraints, interfacial H-bonding and materials characteristics for an overall optimal mechanical performance such as strength, toughness and ductility.


**Biography:** Dr. Shahsavari's research focuses on developing a multi-scale, multi-paradigm materials modeling approach extending from the quantum level to the continuum level to study key functional behavior of complex materials, which are critical to the infrastructure underlying the science and technology enterprises of our society. He has developed a broad foundation of knowledge and experience in engineering, mechanics, materials, and modelings. Prior to joining Rice University, he completed his Ph.D at MIT and prior to that, he was a project engineer for a Canadian Engineering, Procurement and Construction Management firm in Alberta. He is the recipient of several prestigious awards in both academia and entrepreneurship including three-year fellowship from the National Research Council of Canada (NSERC), MIT $100,000 Grand Prize in Entrepreneurship Contest, Silver Medal in Material Research Society, Stephen Brunauer award for the best paper in the American Ceramic Society, etc.