

Multi-scale modeling and AI -guided development of multifunctional nanomaterials for space technologies

Paras N Prasad

Institute for Lasers, Photonics and Biophotonics

Departments of Chemistry, Physics, Electrical Engineering and Medicine

State University of New York at Buffalo, Buffalo, New York 14260

This presentation will highlight pioneering, multidisciplinary convergent science research conducted at our institute, which integrates modeling, nanotechnology, and photonics for space applications. By leveraging novel chemical synthesis and materials processing techniques, we create AI and multiscale modeling-guided, multifunctional core-shell nanoparticles, 2-D materials, their mixed heterostructures and polymer nanocomposites. These are designed for transformative applications in space electronics ground-to-space photonic communications and space awareness. Innovations in materials capable of self-repair, adaptation to changing conditions, and resistance to extreme temperatures, high pressures, and high-radiation environments are being explored. Applications range from protective coatings for aerospace vehicles to resilient structural materials for critical infrastructure. Special emphasis has been placed on the development of multifunctional materials that combine photonic or electronic properties with shielding capabilities against ionizing radiation or electromagnetic interference (EMI), including elastomers, reduced-dimensionality materials, and lightweight structures with radiation hardening properties.

Finally, a new research direction we are developing is space biology where our focus is to develop sensing platform for quantifying human performance in extreme environments of space which pose profound challenges to physiology and cognition.

This talk will conclude with a discussion of new opportunities for research and technological innovation.

P. N. Prasad "***Nanophotonics***" John Wiley & Sons, (2004)