Bio-nanoparticles: Determining fundamental physical properties and bio-medical applications through laser induced pressure and cavitation

Laser energy absorbed by nanoparticles is transduced into different thermo-mechanical channels: heat, explosive vaporization, and shock fronts. The underlying physics involves non-linear effects and displays complex dependencies on thermomechanical properties. For nanoparticles, sub-picosecond laser pulses can be used to tune the energy transduction into the different physical channels. This tuning of the physics of the response can be used to measure fundamental thermo-mechanical properties of nanoparticles. Once the thermo-mechanical properties of a nanoparticle are known, the nanoparticle can be used as a means to transduce laser energy to introduce various forms of stimuli on the surrounding material, such as intense heating, explosive vaporization, or generation of shock-waves. The thermo-mechanical stimuli can be tailored to produce desired outcomes in the surrounding material, such as microscopic annealing, localized chemical reactions, fracturing, and biological cell-death. The nanoparticles in the material can either be naturally occurring such as melanosomes in biological cells, or introduced such as gold or graphite nanoparticles.

Biography

Bernard S. Gerstman is Chairman of the Department of Physics at Florida International University, and Executive Editor of the journal American Institute of Physics Advances. Professor Gerstman received his Ph.D. in Physics from Princeton University, and then obtained a position as a Post-Doctoral Researcher in the Physics Department at the University of Virginia. After finishing his post-doctoral work, Prof. Gerstman accepted a tenure-track position in the Department of Physics at Florida International University where he has risen through the ranks based upon his research and teaching accomplishments. Professor Gerstman’s research interests have focused on the physics of biomolecules, nanomaterials, and biological cells. The use of lasers to investigate and alter the properties of these materials has been an integral part of his research. Professor Gerstman has also been a consultant to the United States Air Force and the British Ministry of Defense.

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