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Mechanical response of composites in the presence of an electromagnetic field

Motivation experimentally observed increase in strength of *carbon fiber polymer matrix composites* in response to an electric current

Our focus theoretical and experimental work on dynamic response of composites in the presence of an electromagnetic field

Awards

- ASME/Boeing 2007 Structures & Materials Award
- 2006 American Society for Composites Best Paper

Major publications

- Zhupanska O. I., Sierakowski R. L. "Effects of an Electromagnetic Field on the Mechanical Response of Composites", *Journal of Composite Materials*, 41 (5), 2007, pp. 633-652
- Sierakowski R. L., Telitchev I. Y., and Zhupanska O. I. "On the Impact Response of Electrified Carbon Fiber Polymer Matrix Composites: Effects of Electric Current Intensity and Duration", *Composites Science and Technology*, in press
- Telitchev I. Ye., Sierakowski R. L., and Zhupanska O. I. "Low Velocity Impact Testing of Electrified Composites; Part I. Application of an Electric Current", *Experimental Techniques*, in press
- Telitchev I. Ye., Sierakowski R. L., and Zhupanska O. I. "Low Velocity Impact Testing of Electrified Composites; Part II. Experimental Setup and Preliminary Results", *Experimental Techniques*, in press.



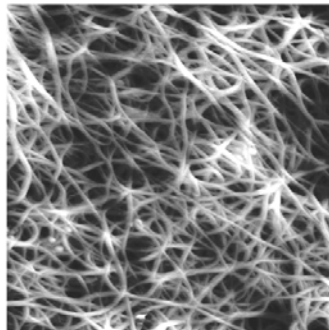
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Modeling of Buckypaper Nanocomposites



- single-wall carbon nanotubes have exceptional mechanical properties
- mechanical properties of buckypaper nanocomposites do not measure up to theoretical limits



Objective

- develop mathematical multiscale models for prediction of the effective properties and strength of buckypaper nanocomposites

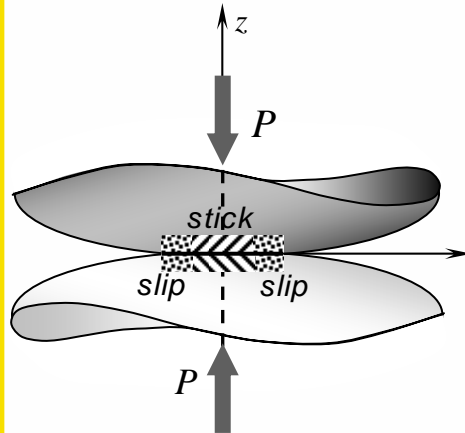
Part of collaborative project with Florida State University, Lockheed Martin, and AFRL: "*Investigation and Optimization of High Performance Nanocomposites Produced with Nanotube Buckypaper Materials*", sponsored by AFOSR, 2005-2009



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Contact Mechanics



Areas of research

- finite geometry of contacting bodies
- friction in the contact zone
- adhesion of contacting surfaces
- finite deformations
- analytical solution methods

Major publications

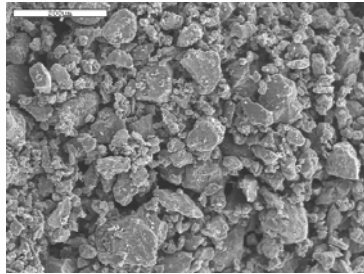
- Zhupanska O.I. "On the Analytical Approach to Galin's Stick-slip Problem. A Survey", *Journal of Elasticity*, in press
- Zhupanska O. I., Ulitko A. F. "Contact with Friction of a Rigid Cylinder with an Elastic Half-Space", *Journal of the Mechanics and Physics of Solids*, 53 (5), 2005, pp. 975-999
- Eskin D., Zhupanska O., Hamey R., Moudgil B., and Scarlett B. "Micro-hydrodynamic Analysis of Nanogrinding in Stirred Media Milling", *AIChE Journal*, 51 (5), 2005, pp. 1346-1358
- Zhupanska O. I. "The Determination of Adhesion and Slip Zones under Indentation of an Elastic Half-Space by a Rigid Sphere", *Mechanical Engineering*, 4, 1999, pp. 40-46
- Zhupanska O. I. "Frictional Interaction of a Rigid Cylinder with an Elastic Half-Space", *Math. Methods and Phys.-Mech. Fields*, 2, 1999, pp. 125-134
- Zhupanska O. I., Martynenko M. A. "The Contact Interaction of Elastic Spheres without Hertz Theory Limitations", *Nonlinear Boundary-Value Problems of Mathematical Physics and Applications*, *Institute of Mathematics*, Kiev, 1998, pp. 94-97



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Mechanics of Particulate Materials



- Constitutive modeling of particulate materials
- Micromechanics
- Discrete element modeling

Research projects

- Elastic/viscoplastic modeling of powders
- Nanogrinding
- Micromechanics of high strain rate penetration

Major publications

- Eskin D., Zhupanska O., Hamey R., Moudgil B., and Scarlett B. "Microhydrodynamics of Stirred Media Milling", *Powder Technology*, 156 (2-3), 2005, pp. 95-102.
- Eskin D., Zhupanska O., Hamey R., Moudgil B., and Scarlett B. "Microhydrodynamic Analysis of Nanogrinding in Stirred Media Milling", *AIChE Journal*, 51 (5), 2005, pp. 1346-1358.
- Pitchumani R., Zhupanska O., Meesters G.H., and Scarlett B. "Measurement and Characterization of Particle Strength Using a New Robotic Compression Tester", *Powder Technology*, 143-144, 2004, pp. 56-64.
- Zhupanska O. I., Abdel-Hadi A. I., and Cristescu N. D. "Mechanical Properties of Microcrystalline Cellulose; Part II. Constitutive Model", *Mechanics of Materials*, 34, 2002, pp. 391-399.
- Abdel-Hadi A. I., Zhupanska O. I., and Cristescu N. D. "Mechanical Properties of Microcrystalline Cellulose; Part I. Experimental Results", *Mechanics of Materials*, 34, 2002, pp. 373-390.