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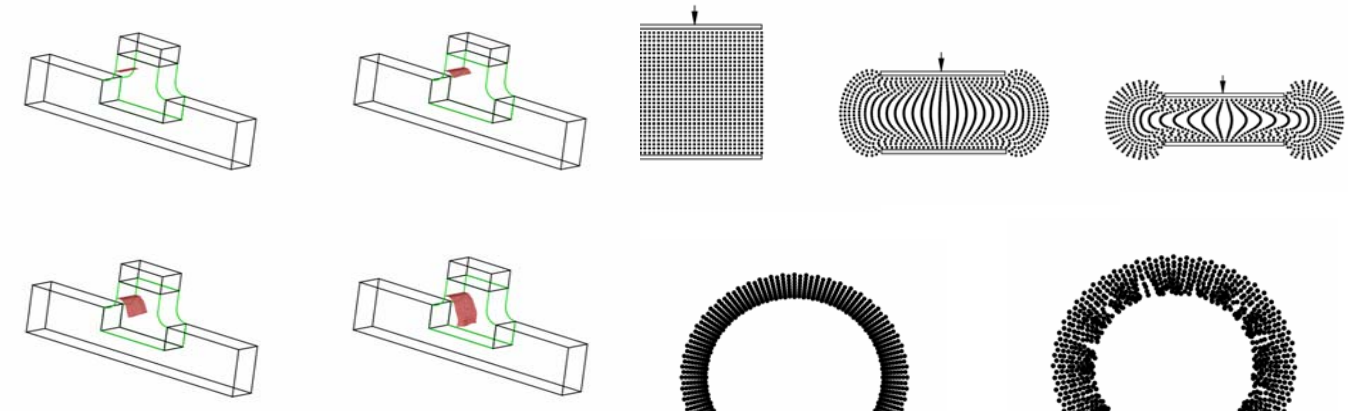
Computational Multiscale Mechanics Laboratory (CMML)

Meshfree Particle Methods (Macro-scale ~1m)

- Deformations and fractures
- Stability Analysis
- A coupling method of meshfree particle method with finite element method



Meshfree particle method coupled with FEM for 3D crack propagation

- Rabczuk, **Xiao** and Sauer, *Communications for Numerical Methods in Engineering*, Vol 22(10), 2006, pp 1031-1065
- **Xiao** and Belytschko, *Advances in Mathematical computation*, Vol 23, 2005, pp 171-190
- Rabczuk, Belytschko, and **Xiao**, *Computer Methods in Applied Mechanics and Engineering*, Vol. 193, 2004, pp. 1035-1063
- Belytschko and **Xiao**, *Computers and Mathematics with Applications,* Vol. 43(3-5), 2002, pp.329-350

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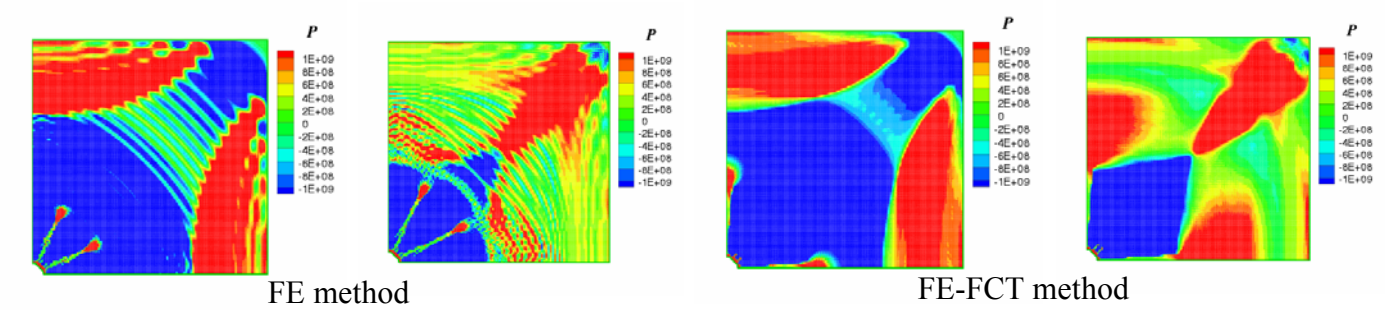
Shock Wave Propagation (Macro-scale ~1m)

- The flux-corrected transport (FCT) algorithm is implemented to eliminate the fluctuations behind shock wave fronts
- Precisely describe shock wave propagation and interaction
- Accurately predict spallation

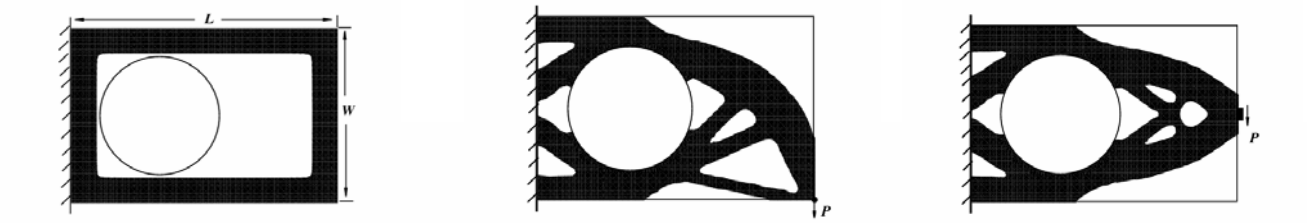


FE method FE-FCT method

- **Xiao**, *Communications for Numerical Methods in Engineering*, Vol 23, 2007, pp 71-84
- **Xiao**, *International Journal for Numerical Methods in Engineering*, Vol 66, 2006, pp 364-380
- **Xiao**, *Wave Motion*, Vol 40, 2004, pp 263-276

Topological Optimization (Meso-scale ~1mm)

- Structured extended finite element method
- An implicit function is used to describe the boundary



- Belytschko, **Xiao** and Parimi, *International Journal for Numerical Methods in Engineering*, Vol. 57, 2003, pp.1177-1196

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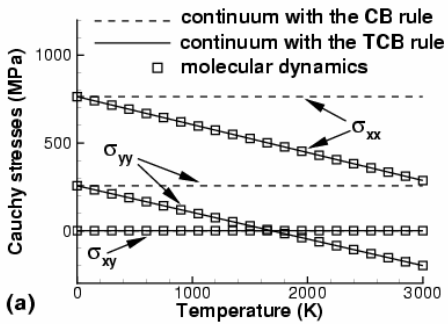
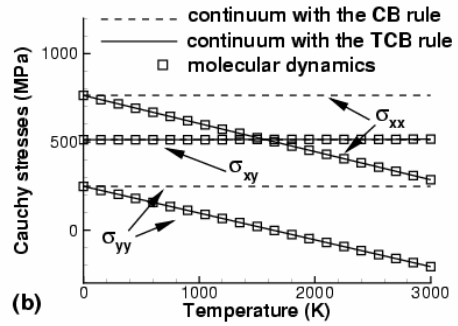
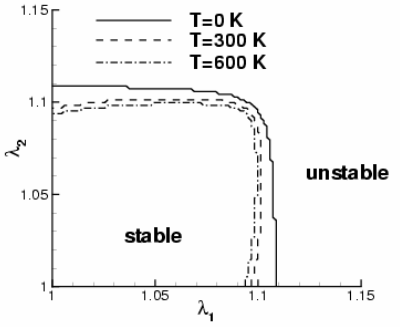
Temperature-Related Homogenization (Micro-scale ~1μm)

- Temperature-related Cauchy-Born (TCB) rule
- Verifications and material stability analysis



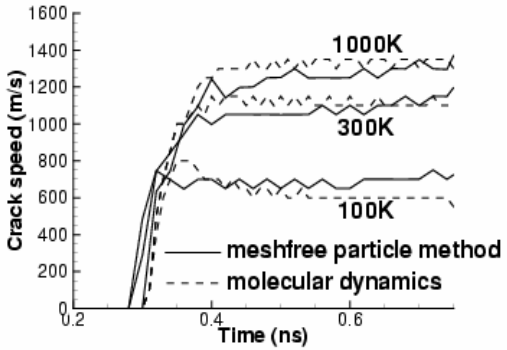


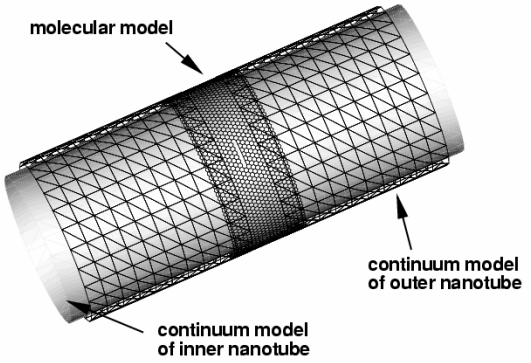


- **Xiao** and Yang, *International Journal for Numerical Methods in Engineering*, 2007, in press
- **Xiao** and Yang, *Computational Materials Science*, Vol 37, 2006, pp 374-379

Multiscale Methods (Micro/Nano-scales ~1μm-1nm)

- Bridging domain coupling method
- Nanoscale meshfree particle method





- **Xiao** and Yang, *International Journal of Computational Methods*, Vol. 2(3), 2005, pp. 293-313
- **Xiao** and Belytschko, *Computer Methods in Applied Mechanics and Engineering*, Vol. 193, 2004, pp. 1645-1669
- Belytschko and **Xiao**, *Journal of Multiscale Computational Engineering*, Vol. 1(1), 2003, pp.115-126

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Nanotubes and Nanocomposites (Nano-scale ~1nm)

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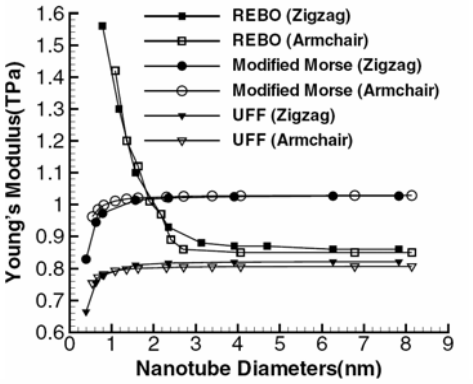
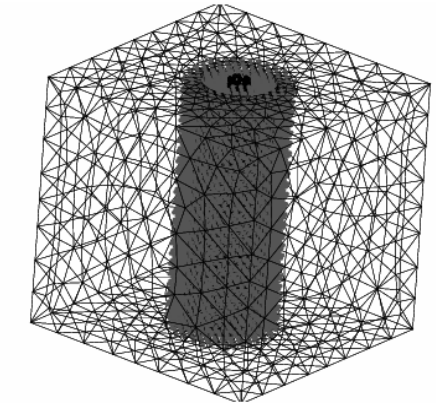
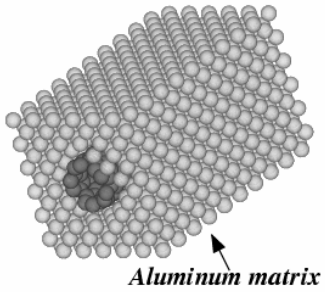
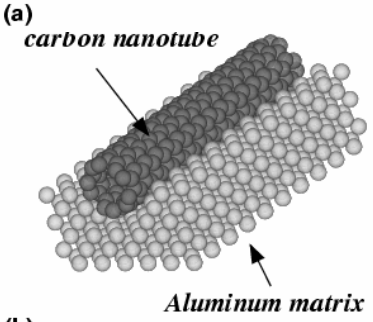
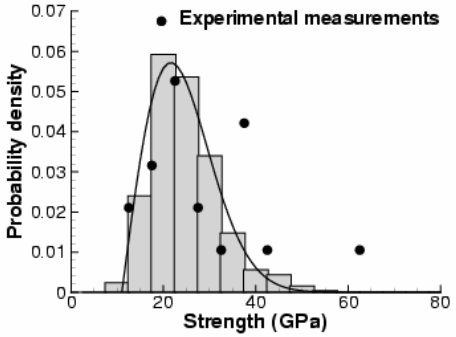
- Size effects on carbon nanotubes' mechanical properties
- Mechanics of Defect-free and defective carbon nanotubes
- Reliability analysis of nanotubes
- Mechanics of nanotube-based composites
- Molecular dynamics and multiscale simulations

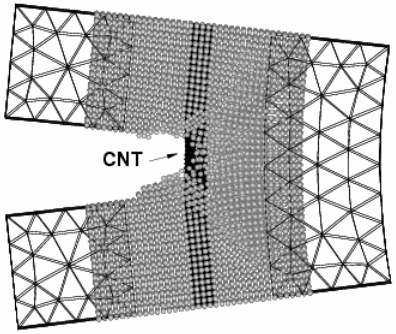


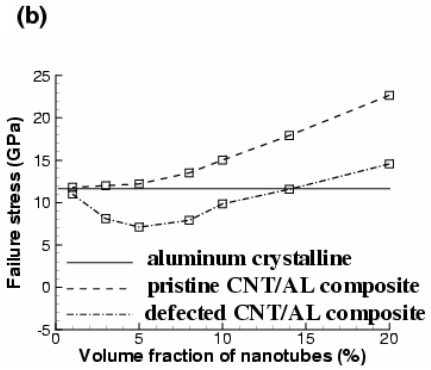












- **Xiao** and Hou, submitted to *International Journal for Multiscale Computational Engineering*, 2007
- **Xiao** and Hou, submitted to *Journal of Nanoscience and Nanotechnology, 2007*
- **Xiao** and Hou, *Physical Review B*, Vol 73, 2006, 115406
- **Xiao** and Hou, *Fullerenes, Nanotubes, and Carbon Nanostructures* , Vol 14, 2006, pp 9-16
- Mielke *et. al.*,and **Xiao**, *Chemical Physics Letters*, Vol 390, 2004, pp 413-420
- Belytschko, **Xiao** Schatz and Ruoff, *Physical Review B*, Vol 65, 2002, 235430

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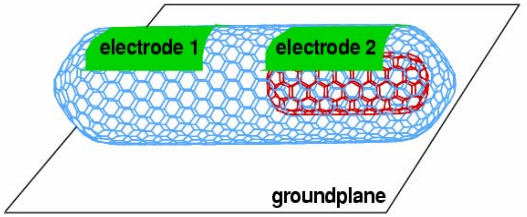
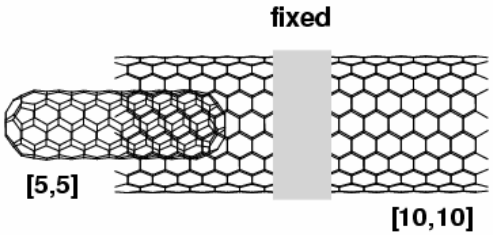
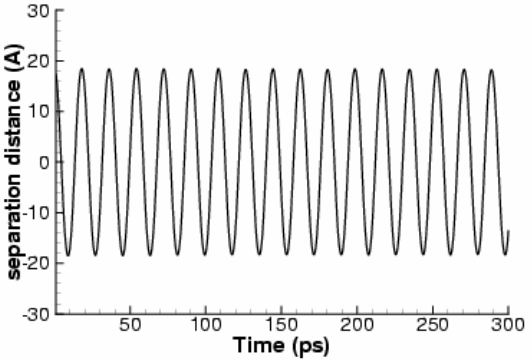
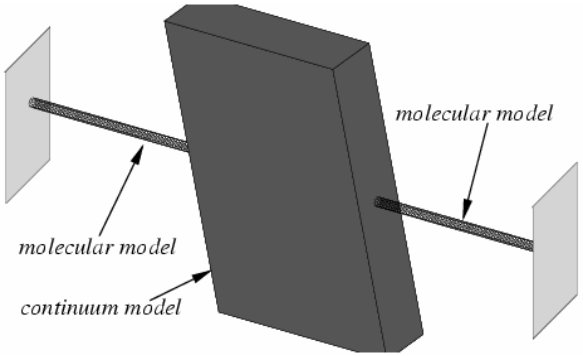
Nanotube-Based Devices (Nano-scale ~1nm)

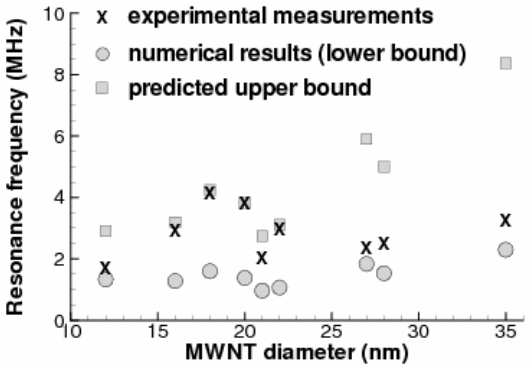
- Nanotube-based co-axial oscillators
- Nanotube-based resonant oscillators
- Nanotube-based memory cell
- Molecular dynamics and multiscale simulations











- **Xiao** and Hou, *Physical Review B*, 2007 in press
- **Xiao** *et. al., International Journal of Computational and Theoretical Nanoscience, Vol. 3, 2006, pp 142-147*
- **Xiao** *et. al., International Journal of Nanoscience*, Vol 5(1), 2006, pp 47-55