In situ measurements of Factors Controlling the Structure and the Morphology of Carbon Nanotubes

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Carbon nanotubes are one of the most studied materials during last two decades due to potential applications that range from nanotechnology to biotechnology. Inspite of such a large research effort, their controlled synthesis remains an elusive goal. It has been shown that dynamic observations using environmental transmission electron microscopy can be used to understand nucleation and growth of CNTs. We have applied this technique to understand and control the growth rate, structure and morphology of CNT's formed using Ni/SiO_2 catalyst and acetylene as the carbon source. Our measurements show that both the structure and morphology depend upon the reaction temperature and pressure. Our preliminary results also show that reaction temperature, pressure and activity for CNT synthesis are also dependent on the nature of the catalyst. This presentation will include statistical analysis of in situ real-time observations (videos), controlled synthesis of model catalyst particles using electron beam-induced decomposition of metal-organic precursors, and the effect of support grids on CNT growth. Current limitations and future developments for in situ observations of catalytic processes using ESTEM will also be discussed.

Short Bio:

Dr. Renu Sharma is a Project Leader in the Nanofabrication Research Group. She received a B.S. and B.Ed. in Physics and Chemistry from Panjab University, India, and M.S. and Ph.D. degrees in Solid State Chemistry from the University of Stockholm, Sweden, where she had a Swedish Institute Fellowship. Renu joined the CNST in 2009, coming from Arizona State University (ASU), where she began as a Faculty Research Associate in the Department of Chemistry and Biochemistry and the Center for Solid State Science, and most recently served as a Senior Research Scientist in the LeRoy Eyring Center for Solid State Science and as an affiliated faculty member in the School of Materials and Department of Chemical Engineering. Renu has been a pioneer in the development of environment cell transmission electron microscopy (E(S)TEM), combining atomic-scale resolution with dynamic chemical analysis of gas-solid reactions. She has applied this powerful implementation of TEM to characterize the atomic-scale mechanisms underlying the synthesis and reactivity of nanoparticles (including catalysts), nanotubes, nanowires, inorganic solids, ceramics, semiconductors, and superconductor materials. Renu has received a Deutscher Akademischer Austauschdienst (DAAD) Faculty Research Fellowship, is a past President of the Arizona Imaging and Microanalysis Society, and has over 140 publications. At the CNST, she is establishing advanced TEM measurement capabilities for nanoscience research and overseeing the operation of a new TEM facility in the NanoFab.