Time-Resolved Diagnostics and Mechanisms of Single-Wall Carbon Nanotube Synthesis by the Laser Vaporization Technique

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Single-wall carbon nanotubes (SWNT) exhibit novel electrical, mechanical, and optical limiting properties which make them a key material for next generation electronic devices, optoelectronics, and structural materials. Laser ablation of graphite / metal catalyst targets inside a hot oven environment is the technique which currently produces the highest quality SWNT. In order to scale-up SWNT production to enable future applications, the growth mechanism must be determined. We have performed time-resolved, *in situ* imaging and laser spectroscopy of the plume of vaporized material, along with *ex situ* TEM analysis of deposits collected under direct diagnostic monitoring, to determine that the majority of SWNT growth occurs over seconds of time from a feedstock of carbon clusters and nanoparticles by a *condensed phase conversion* process. These experiments will be described, as well as ex situ annealing experiments of laser-generated SWNT 'seeds' and particles, which indicate the possibility for a new manufacturing approach for SWNT production.