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Investigation of Nanotube Growth Kinetics via In-Situ Spectroscopy RAHUL RAO, AFRL, UTC Inc., DAVID LIPTAK, AFRL, UES Inc., ROBERTO ACOSTA, BENJI MARUYAMA, AFRL, AFRL TEAM — Analysis of single-walled carbon nanotubes (SWNTs) during growth via Raman and fluorescence spectroscopy offers a unique approach to understand and control their growth, which remains challenging due to a large variability of synthesis parameters. In our technique individual SWNTs are grown via chemical vapor deposition inside an environmental cell coupled to an automated stage on a light microscope. Laser-induced growth occurs from catalyst nanoparticles on thermally isolated islands within substrates where the micro-Raman excitation laser also serves as the localized heat source. Computer control over substrate temperature, position, feed gas composition, and chamber pressure enable rapid real-time exploration of SWNT growth parameter space. Micro-Raman spectra are collected in-situ from the low frequency radial breathing mode and D/G band regions of the growing SWNTs. The evolution of the G band of individual SWNTs over time is modeled with an exponential growth equation and indicates rapid time constants and consequently short catalyst lifetimes. Comparison of SWNT growth kinetics from various catalyst particles will be presented and implications for controlled growth of SWNTs will be discussed.

Rahul Rao
AFRL, UTC Inc.

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