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Co-optimizing carbon nanotube synthesis: control of diameter, structural quality, and growth kinetics along with simultaneous cost minimization ERIC R. MESHOT, Department of Mechanical Engineering, University of Michigan, DESIREÉ L. PLATA, Department of Civil and Environmental Engineering, MIT; Marine Chemistry and Geochemistry Department, Woods Hole Oceanographic Institute, CHRISTOPHER M. REDDY, Marine Chemistry and Geochemistry Department, Woods Hole Oceanographic Institute, PHILIP M. GSCHWEND, Department of Civil and Environmental Engineering, MIT, A. JOHN HART, Department of Mechanical Engineering, University of Michigan — We employ a decoupled CVD method that not only facilitates control of mean diameter and structural quality of vertically aligned CNTs, but also co-optimization of kinetics for efficient growth to "forest" heights of several millimeters. The growth substrate temperature (Ts) governs agglomeration of the catalyst film which primarily determines CNT diameter, while structural quality monotonically increases with Ts. Independent heating (Tp) of the reactant mixture generates a strikingly diverse population of active hydrocarbons. These analyses, in concert with real-time laser measurements of forest growth rate and height suggest that select products of gas treatment promote growth, while excessive gas-phase pyrolysis of hydrocarbons adversely affects the CNT structure. Further, we directly inject select compounds in the absence of thermal treatment, thus minimizing energetic costs.

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