Microwave-mediated, Plasma-assisted Nanographene Aerosol Production

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Graphene is the latest carbon allotrope, revolutionizing carbon science and igniting commercial interests. Synthesis processes are well known, beginning with mechanical exfoliation, varied graphene oxide (GO) routes and chemical vapor deposition (CVD). The former two processes begin with a pristine sp^2 carbon framework, with the GO path requiring its restoration. The CVD approach is by contrast a bottom-up approach in contrast to the former two being top-down approaches. It requires however a metal catalyst to activate the hydrocarbon decomposition and/or mediate the sp^2 framework formation. Without this metal an amorphous form of carbon forms, either as pyrolytic deposition if upon a surface or as a form of "soot" if as an aerosol. This presentation highlights aerosol formation of graphene nanoplatelets and graphitic particles in a microwave plasma. Whereas pyrolytic decomposition of hydrocarbons produces unstructured carbon, the nanoplatelets are characterized by dimensions of 200 – 500 nm, occurring in stack of 2-6 with morphology resembling mildly crumpled paper. Accompanying spectral diagnostics are used to characterize the reacting flow. Possible formation paths will be discussed. The co-production of hydrogen and high-value carbon materials from natural gas offers opportunities to reduce the costs associated with distributed hydrogen energy production while also producing synthetic carbon products such as the graphene nanoplatelets. H Quest Vanguard Inc. is developing microwave plasma processes for a wide range of applications, including modular, compact, and portable conversion of natural gas. Sharp reduction in costs of production of high-performance carbon-based nanoadditives may transform the construction, automotive, plastics, and other established industries.