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**Flame-formed nanoparticles in energy applications**

Formation of condensed-phase materials is ubiquitous in many flame phenomena. Combustion as a method of material synthesis has a rich history. A classical example is soot or carbon black that found its uses dating back to the prehistoric time. More recently, carbon nanoparticles have found applications as materials for alternative energy conversion ranging from rechargeable batteries to photovoltaic devices. Condensed-phase materials other than carbon can be produced in gaseous flames by introducing elements beyond the common constituents of gaseous hydrocarbon flames. For example, metals or metal precursors can be added in unburned fuel-oxidizer mixtures or burned gases to produce metal oxide nanoparticles. New advances include specialty nanoparticles and films produced from them for applications in catalysis, solar cells and biomedical devices.

Beyond their common origin in flames**,** flame soot formation and functional nanomaterial synthesis by flames share many common characteristics. Both involve the formation of condensed-phase materials from gases starting with vapor-phase nucleation, followed by mass and size growth through coalescence, coagulation, surface reactions and condensation of vapor species, and finally by aggregation into fractal structures, all of which occur over very short periods of time, typically a few milliseconds. Similar diagnostic and computational tools are employed to study the formation of both condensed-phase materials.

This talk has three parts. We shall discuss the features common to the formation of soot and metal oxide particles in flames. In the second part, we discuss how a long history of fundamental flame studies helped us to advance useful concepts and applications for flame synthesis of functional nanomaterials using the fabrication of thin films of mesoporous metal oxide nanoparticles as the example. Finally, the applications of material synthesis for applications in dye sensitized solar cells and chemical sensors will be discussed with the goal to demonstrate that gaseous flame synthesis offer many advantages over traditional methods of material processing.