# Flame Synthesis of One-Dimensional Metal Oxide Nanomaterials

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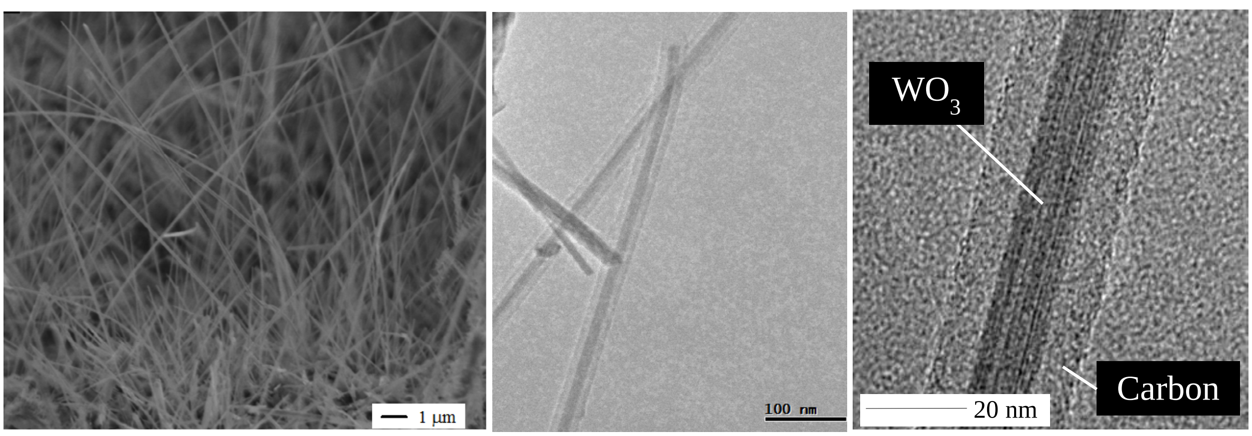
Robust, scalable, and energy efficient methods of nanomaterial synthesis are needed to meet the demands of current and potential applications. Flames have been successfully applied for the synthesis of metal oxide and ceramic nanopowders largely composed of spherical particles and their aggregates. In recent years, premixed and diffusion flames have been employed for the synthesis of 1-D carbon nanoforms such as carbon fibers and carbon nanotubes. The extension of flame methods to gas phase and solid support synthesis of 1-D inorganic nanoforms is of great interest and significance. This talk presents results on flame synthesis of 1-D transition metal oxide nanostructures. The synthesis is performed using high purity metal probes inserted into an opposed-flow methane oxy-flame. The high temperature reacting environment of the flame tends to convert elemental metals into high purity layers of metal oxide nanorods.

1-D oxides of iron, molybdenum, tungsten, and zinc are generated directly in flames by the synergetic probe-flame interaction in the highly reactive flame environment possessing strong thermal and chemical gradients. Experiments on gas phase and solid support synthesis exhibit the surprising diversity of generated nanoforms. The structure and morphology of the generated nanomaterials are analyzed using advanced material diagnostic techniques. The synthesis mechanisms are discussed.




*Flame generated composite tungsten oxide nanowires consisting of $WO_3$ core and graphitic shell.*