

## **602e Novel Combustion Synthesis of Advanced Oxide Ceramics**

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We recently developed a novel process to rapidly produce high purity, submicron, porous powders of complex oxides. This process Carbon Combustion Synthesis of Oxides, (CCSO) is a modified form of self-propagating high temperature synthesis (SHS) that uses carbon as a fuel instead of a pure metal. The CCSO advantage over the SHS is that it enables a more economic synthesis of complex oxides when the price of the pure metal is a large fraction of the reactant mixture. It also enables synthesis of some oxides (for example LaGaO<sub>3</sub>) under situations that SHS cannot be applied due to the fine metal powder being pyrophoric or melting at room temperature. The combusted carbon is emitted from sample as carbon dioxide and its high rate of release increases the porosity and the friability of the product. We used the CCSO to produce several advanced oxide ceramics such as ferroelectric (BaTiO<sub>3</sub>), solid-oxide fuel cell component (LaGaO<sub>3</sub>), battery electrode material (LiMn<sub>2</sub>O<sub>4</sub>) and soft magnetic ferrite (Mn<sub>0.25</sub>Zn<sub>0.75</sub>Fe<sub>2</sub>O<sub>4</sub>) by CCSO. The reactant mixture contains in addition to oxides and/or carbonates about 10-15wt% a carbon powder. Following local ignition, the exothermic reaction between carbon and oxygen, ( $\Delta H = -393.5$  kJ/mol), provides the heat for the solid reactions and heats the adjacent reactant layer. This generates a self-sustaining temperature (up to 1300° C) wave that propagates through the reactant mixture at a velocity of up to 3.5 mm/s. The major parameters affecting the process are the carbon concentration in the reactant mixture and the ability of the oxygen infiltration to the reaction zone. A stable self-propagating reaction front can be obtained only at carbon and oxygen concentrations exceeding a critical value. The reaction front temperature and average velocity increased as the carbon concentration in the reaction mixture increased approaching eventually asymptotic values. The concentration of the carbon in the reactant mixture enabled control of the moving front temperature and average velocity as well as the particle size and surface area.