PARTICLE SYNTHESIS IN FLAMES

P. Roth, P. O. Ifeacho

Institut für Verbrennung und Gasdynamik,
Universität Duisburg-Essen, 47048 Duisburg, Germany

Abstract

The formation of oxidic particles in flames is widely used for the production of ceramics, semiconductors, or fibre optics. The comparably simple setup and the easy scale-up of these processes allow the production of large quantities of powders having certain characteristics. Several types of flame reactors have been in the focus of many researchers in the past, including diffusion, counter-flow diffusion, and premixed flames. In this present work, the formation of tin-oxide (SnO_2), gallium oxide, and mixed oxides are studied in a laminar premixed low-pressure H_2/O_2/Ar flame, doped with respective precursors. The characteristics of the flame generated particles were studied using X-ray diffraction, TEM, UV-VIS analysis, as well as particle mass spectrometer, PMS.

The experimental setup used in this study consists of the low-pressure flame reactor, thermophoretic, and molecular beam sampling devices. Different amounts of the metalorganic precursors were added to the burner stabilized flame. The hydrogen-oxygen flame was burnt under lean condition with the H_2/O_2 ratio of 1.69. Argon was added as a diluent in order to vary the flame temperature. The molar ratio, with respect to the reactive gas was 1.36. The metalorganic precursors were vaporized and mixed with Ar by the partial pressure method in a mixing vessel. The sampling devices used for *ex-situ* measurements, consist of a cooled substrate disposed inside the reaction chamber for particle collection, and a commercial TEM grid sampling device, which was moved rapidly through the flame, thus sampling particles. For the *in-situ* measurements, molecular beam samples were taken from the flame gases and analysed on the basis of particle mass using a particle mass spectrometer.

In a series of experiments, the properties of flame generated oxidic nanoparticles were investigated by the above-mentioned *ex-situ* methods. The dependence of BET surface area, composition and particle size with respect to dopant concentrations in the flame were studied by varying the precursor gas flow. The results obtained show that the solid phase formed in the low-pressure flames is the expected oxidation product of the respective metal in the flame.