Flame synthesis of iron oxide nanoparticles

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The description of the detailed kinetics of the nanoparticle formation during combustion synthesis is an open and widely-debated topic, since combustion synthesis is of considerable interest both in fundamental and applied research. The main challenge in such kind of studies is the heterogeneity of the system, which demands employing diagnostics integrating state-of-the art methods from several fields.

In this work we studied the kinetics and the mechanism of the formation of iron oxide nanoparticles in a low pressure hydrocarbon flame doped with iron pentacarbonyl. The newly-built apparatus allowing to combine several methods for characterization of both gas phase intermediate molecules and solid state nanoparticles was used for this purpose. For measurement of spatial profiles of nanoparicle concentration and their sizes a method integrating molecular beam particle mass spectrometer (PMS) and quartz crystal microbalance (QCM) was employed (1). PMS allows measurements size distribution of charged nanoparticles and QCM provides information about total nanoparticle mass concentration distribution in flame.

For diagnostics of molecular species in flame various spectroscopic methods were employed. Cavity Ring Down spectroscopy (CRDS) and Laser Induced fluorescence were used for measurement of temperature distribution and concentration profiles of Fe atoms. CRDS was used also for additional characterization of nanoparticles formed in flames. Results of the experiments and their comparison with current models of nanoparticle formation are discussed.

References

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