Chemical Imaging Analysis of Flame Synthesized Nanomaterials

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Development of methods for combustion synthesis and processing of functional nanomaterials, such as porous TiO_2 films for solar cells, requires applications of modern chemical imaging techniques to probe physical and chemical properties of nano particles and thin films. This a challenging task because no single method of analytical chemistry is capable of providing the full range of desired information, and a variety of complementary methods are required for comprehensive characterization of nanomaterials. Over the past decade, there has been a remarkable increase in developments and applications of novel microscopy and micro-spectroscopy techniques for chemical imaging analysis of particles and nanomaterials allowing a fundamental understanding of their interior and lateral chemical heterogeneity. This presentation will give an overview of recent advances in the chemical imaging approaches and their potential applications for analysis of nanomaterials formed in flames. We report results of our multi-modal chemical imaging study of the meso-porous TiO_2 anodes of Dye Sensitized Solar Cells (DSSC) fabricated using Flame Stabilized on a Rotating Surface (FSRS) technique. We investigate the effects of particle size, porosity, crystal phase, and interfacial properties of the films on the performance of the DSSC devices. We discuss how specific physical and chemical properties of the film can be controlled and tailored for future development of DSSC devices with improved performance.