Technology

Production and processing of aerosols and nanomaterials

One of our core technologies is a flame synthesis process for the production of "Pure Carbon Black". We make use of an inverted flow reactor wherein a diffusion flame of methane and air is used to generate Carbon Black aerosol. Among the many notable features of this unique configuration are the flame's remarkable stability and its capacity to continuously generate a wide range of nearly constant concentrations of carbon black particles. Extensive laboratory analysis of the carbon black particles using various standardized techniques show that the particles contain around 95-99% pure elemental (graphitic) carbon with little or no organic carbon content. When thermophoretically sampled directly from the flame, the carbon black particles show up as "Aerosol-Gel" under an electron microscope.

Apart from the aforementioned technique, our research team makes use of the latest advances in flame aerosol technology for inexpensive synthesis of titania, silica and other oxide and carbon powders. The past decade has seen our researchers developing and using diffusion and premixed flame reactors to make aerosols with precisely controlled shape, crystallinity, size and specific surface area.

Very recently (2007), we invented a patent-pending, charge-based technique that accomplishes particle segregation based on morphology. This technique was tested on flame-generated soot aerosols where singly and doubly net-charged agglomerates of similar sizes were segregated using electrostatic classifiers and were shown to have different morphologies. This simple technique has the potential for immediate application in the material subfields of pharmaceuticals, nanopowder synthesis, and carbon nanotube production.

Modeling and simulation of particles and particle-formation processes

The modeling of particle formation represents a continuing challenge in particle technology. Our research group has been actively involved in studying the fundamentals governing processes related to agglomeration and deagglomeration (dispersion) of particle powder clusters on lab systems which enable precise control of key parameters. We start from fundamental concepts and equations to develop quantitative models. Experimental investigations are used to gain insight into the factors which govern the phenomena, and our models are further validated against experimental data. We have recently developed a comprehensive aerosol simulation package, FracMAP, which simulates 3-dimensional (3-d) quasi-fractal agglomerates and creates their 2-dimensional (2-d) pixelated projection images by restricting them to stable orientations as commonly encountered for quasi-fractal agglomerates collected on filter media for electron microscopy. The package also enables to calculate the fractal dimensions and other structural projection properties of the agglomerates, the knowledge of which will help experimentalists in extracting 3-d structural information from 2-d images of real aerosol particles.