115e Real Time Measurement of Sintering Rates by Tandem Mobility Dma and an Electrospray System

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Sintering plays a key role during gas phase synthesis in high temperature reactors. The primary particle size is controlled by this process, and the eventual properties of the nanoparticles such as photoreactivity depend on this size. A tandem differential mobility analyzer (DMA) system has been used to determine the sintering rates of pristine and doped titanium dioxide. The first DMA was used to select a single mobility size, and this agglomerate was made to go through a varied time-temperature history to establish the sintering rate. The mobility diameter changes were measured by the second DMA, and surface areas were obtained from the measured data. Existing solid state diffusion theories for sintering mechanisms are evaluated, and an effective diffusion coefficient was determined by comparing the experimental data to the theoretical expression. A geometric approximation was developed to determine the sintering rate expression, and compared to the more traditional surface area change model extensively used by other researchers. Results indicate that V-doped TiO2 sinters faster than the pristine forms of TiO2. Sintering studies were also conducted with polystyrene latex (PSL) particles where viscous liquid flow governs the rate. An electrospray set up was used to produce doublets and triplets of polystyrene latex particles, which were systematically heated and the change in the mobility diameter determined by a DMA. Sintering rate expressions based on surface tension and viscosity were then used to compare experimental observations to the measured data.