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***In situ* USAXS Studies of Nucleation and Particle Growth in the Flame Aerosol Process.** N. Agashe[1], G. Beaucage[1], H. Kammler[2], R. Jossen[2], P. Jemian[3], S. Pratsinis[2], [1]Dept. of Chemical and Materials Engineering, Univ. of Cincinnati, Cincinnati, OH 45221, USA, [2]Particle Technology Laboratory, Dept. of Mechanical and Process Engineering, ETH Zurich, Zurich, Switzerland CH-8092, [3] UNICAT, Advanced Photon Source, Argonne National Lab & Univ. of Illinois, Urbana, IL 6180, USA.

Ultra small angle x-ray scattering (USAXS) in used as an in situ technique to characterize titania particles made by high temperature flame method. Due to the extremely fast nature of the reaction and low concentrations associated with this process, it is difficult to accurately observe the formation of nuclei and their growth to form aggregated nanoparticles by thermophoretic sampling. The high brilliance of synchrotron radiation provides a method to study in situ particles at low concentrations. The Bonse-Hart camera of the USAXS instrument at UNICAT (APS, Argonne) can measure a wide range of size from nanometer (10^{-9} m) to micrometer (10^{-6} m) and make it possible to simultaneously examine evolution and morphology of these particles. Particle characteristics like the titania volume fraction, primary particle size, polydispersity in this particle size, number concentration, aggregate size and mass fractal dimension ($d_{f,}$) are presented along the flame axis. The aggregates have complex mass fractal shapes which are joined by partial coalescence, ionic bonds and van der Waals forces.