Soot Gelation Kinetics in an Acetylene/Air Diffusion Flame

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Gelation is usually thought of in terms of liquid systems, the formation of gelation gels or the sol to gel transition being common examples. However, under certain conditions acetylene/air diffusion flames create copious amounts of large (~mm) soot particles. In this paper we present evidence that these large particles are a result of an aerosol gelation process.

At low acetylene flow rates, light scattering shows submicron clusters of soot in both the luminous and nonluminous regions of the flame. This soot shows a weak size dependency with flow rate. As the flow rate is increased, a threshold occurs in which large, 10's µm soot clusters suddenly appear. These large clusters have a DLCA morphology with a fractal dimension of ca. 1.8 with as many as 10^8 monomeric particles per cluster [1]. High speed photographs of the flame show these clusters are very dense, i.e., they nearly touch. Optical volume fraction measurements indicate a gel would form when soot cluster sizes are ca. 50 µm, the same as the measured cluster sizes. Kinetic measurements indicate that the growth kinetics necessary to create these large clusters is ca. 10^5 faster than the Brownian kinetics responsible for "normal" soot growth [2]. Thus a novel kinetics must be at work, and we propose it is gelation.

[1] C.M. Sorensen and G.D. Feke, *Aerosol Sci. Tech.* **25**, 328 (1996).
[2] C. Oh and C.M. Sorensen, *J. Aerosol Sci*. (to appear 1997).