

Characterization of Fine and Ultrafine Fly Ash by Electron Microscopy Techniques

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ABSTRACT

Computer Controlled Scanning Electron Microscopy (CCSEM) and analytical transmission electron microscopy (TEM) have been used for characterization and analysis of individual coal fly ash (CFA) particles generated from combustion of four bituminous coals, two subbituminous coals, and a lignite in a 50 kW combustor. CCSEM analysis of the fine (0.3-50 μm) size fraction of CFA showed abundance of aluminosilicates. These aluminosilicates are associated with Ca and Na in Western/low rank coals, while eastern/bituminous CFA samples exhibited significant amounts of Fe-aluminosilicates and K-aluminosilicates. SEM analysis showed porous or solid char particles with heterogeneous microtextures as dominant carbonaceous species in the micron-size fraction. TEM analysis of the ultrafine (<100 nm) sized inorganic CFA particles showed quite different morphologies, compositions and microstructures compared to the coarser particles. An eastern bituminous CFA sample showed abundant discrete crystalline particles rich in Fe, Ti and Al, whereas three western low-rank CFA samples contained considerable amounts of alkaline-earth element aggregates in the form of phosphates, silicates, and sulfates and mixed species. Carbonaceous CFA particles mainly consisted of fractal-like soot aggregates as dominant species in the submicron fraction. Primary soot particles in these fractal aggregates showed relatively homogeneous arrangement of concentrically stacked graphitic layers. Compositional analysis indicates that besides the dominant carbon, discernable S and O are also present in these carbonaceous particles.

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