Detection of Nonvolatile Nanoparticulate Emissions

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3:30 p.m. – 4:30 p.m.; October 26, 2010
125 Butler Carlton Hall

Abstract
Advances in optical diagnostics of nanoparticles have led to the recent emergence of capabilities to measure the concentration and size of nonvolatile aggregated nanoparticles emitted into the atmosphere during the production of energy through fossil fuel combustion. Developments regarding the science of laser-induced incandescence (LII) for the measurement of the mass concentration and morphology of nonvolatile carbon nanoparticle emissions will be discussed. This includes a new approach to LII, autocompensating laser-induced incandescence (AC-LII), which offers benefits in the unambiguous measurement of soot/black carbon nanoparticles. Further optimization of the AC-LII technique to improve the sensitivity was performed, resulting in a high sensitivity autocompensating laser-induced incandescence (HS-LII) system. This is capable of measuring concentrations as low as 20 ng/m³, lower than typical atmospheric concentrations of black carbon, and therefore suitable for almost any application where low soot concentrations are anticipated. Applications of the AC-LII and HS-LII systems to measurements of nonvolatile carbon nanoparticle emissions are presented.

Dr. Greg Smallwood is Program Lead for Environment Monitoring Technologies within the Institute of Chemical Process and Environmental Technology (ICPET) at the National Research Council Canada (NRC). His research has international stature in the development and application of optical diagnostics for combustion, the study of fuel chemistry on emissions, and the use of numerical simulation to develop and apply submodels of the physics and chemistry of combustion. The primary focus is transportation applications, including reciprocating engines and gas turbines. His program features his work on laser-induced incandescence (LII) and related high-energy laser-based diagnostics for nanoparticle characterization. His award-winning nanometrology research has attracted support from industry, leveraged by university graduate students currently co-supervised in his laboratory and funding from the Canadian Government’s Panel on Energy Research and Development (PERD) Particles Program and the Advanced Fuels and Technologies for Emissions Reduction (AFTER) Program. He received degrees in Mechanical Engineering from Queen’s University (B.Sc., 1983), University of Ottawa (M.Sc., 1992), and Cranfield University (Ph.D., 2009).

(Refreshments Served at 3:15 p.m.)