Session Overview: Soot and Particles

Frederik Ossler, Session Chair

Combustion Physics, Lund University, PO Box 118, SE-221 00 LUND, Sweden

Soot and other particles are usually the result of incomplete combustion of carbon containing fuels. They can be produced in high amounts in combustion where strong gradients of temperature and concentrations are present such as for Diesel engines. Soot as we mostly know it shows fractal like structures, which contain subunits with a high degree of spherical symmetry at different scales from fullerenic around or below one nanometer up to the scale of the so called primary particles with typical sizes between 20 nm and 70 nm. There are different studies that indicate that the formation of the soot proceeds by processes of hierarchic aggregation, where small particles on the scale of 1-4 nanometers play an important role and can be found as subunits of the soot particles. Consequently, high concentrations of particles of few nanometers can be expected to be present inside the high-temperature combustion region. These can be released and cause severe damage to the environment and health, because they are hard to capture by filters, can easily diffuse into the atmosphere, penetrate through cellular membranes and affect the RNA and DNA.

Much is still not yet understood about the early stages of soot formation, e.g., how the processes going from the parent fuel molecules, clustering and particle growth proceed and how they relate to the combustion conditions. The reactive radicals that are formed at high temperature as the hydrogen atoms are released from the carbon backbone of the fuel molecules are expected to play an important role for the particle formation. Polycyclic aromatic hydrocarbons (PAHs) have also been considered to play a central role in the early stages. They frequently are detected in-situ by laser-induced fluorescence and appear in the mature soot, but could also be formed in the "nanobulk" of the particles. Due to the different ways carbon can hybridize its atomic orbitals, 1-D and 2-D structures represented, e.g. by nanotube-and graphene like structure can also be obtained from combustion-like processes. Experimental and theoretical tools are currently being developed and used in different parts of the world in trying to reveal and understand the hidden mechanisms of soot and particle formation. Some of these will be presented and discussed in the "Soot and particle" session of this Workshop.