Nucleation particles in Diesel exhaust: Composition inferred from in-situ mass spectrometric analysis

J. Schneider, N. Hock, S. Weimer\textsuperscript{1}, S. Borrmann, 

Cloud Physics and Chemistry Department, Max Planck Institute for Chemistry, Institute for Atmospheric Physics, Johannes Gutenberg University, Mainz, Germany

\textsuperscript{1}Now at: Atmospheric Sciences Research Center, State University of New York, Albany, NY, USA

U. Kirchner, R. Vogt, V. Scheer 

Ford Forschungszentrum Aachen GmbH, Germany

Abstract

Mass spectrometric measurements of size and composition of Diesel exhaust particles have been performed under various conditions: Chassis dynamometer tests, field measurements near a German motorway, and individual car chasing. Nucleation particles consisting of volatile sulfate and organic material could be detected both at the chassis dynamometer test facility and during individual car chasing. We found evidence that if nucleation occurs, sulfuric acid / water is the nucleating agent. Low-volatile organics species only condense on the pre-existing sulfuric acid / water clusters. Nucleation was found to depend strongly on various parameters like exhaust dilution conditions, fuel sulfur content, and engine load. The latter determines the fraction of the fuel sulfur that is converted to sulfuric acid. The organic compounds (volatile and low-volatile) condense only on pre-existing particles, such as both sulfuric acid nucleation particles and larger accumulation mode soot particles. On the latter, also sulfuric acid condenses, if the conditions for nucleation are not given. The overall ratio of sulfate to organic (volatile and low-volatile) is also strongly dependent on the engine load. It was found that the production of nucleation particles even at high engine load can be suppressed by using low sulfur fuel.