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First gaseous sulfuric acid detection in automobile exhaust: implications for volatile nano-particle formation and health risk

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Gaseous sulfuric acid (GSA) is thought to represent an important if not the most important nucleating gas present in modern diesel automobile exhaust. It triggers the formation of new aerosol particles which hereafter grow by condensation and coagulation. Here we report on the first measurements of gaseous sulfuric acid in automobile exhaust. The experiment involved a modern passenger diesel car equipped with an exhaust aftertreatment system composed of an oxidation catalyst (OXICAT) and a diesel particle filter (DPF). The diesel fuel used had an ultra-low sulfur mass fraction of only 5x10(-6). Measured GSA number concentrations reached up to 1x10(9) per cm3 and the infered apparent Fraction of fuel sulfur conversion to GSA was F=0.006-0.18 . Freshly nucleated particles with diameters larger than 3 nm were also measured and reached up to 1x10(5) per cm3 and were positivly correlated with GSA. This suggests that the particles were formed via GSA nucleation. Our measurements also suggest that growth of the freshly nucleated particles was preferably not due to GSA-condensation but was rather due to condensation of condensable organic gases which however did not contribute to nucleation.