Volatility of nanoparticles generated from jet engine lubrication oil

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The characterization of particle emissions from jet aircraft equipped with turbofan engines is an important issue in the assessment of the impacts of aviation on climate and human health. The primary importance of aviation-produced aerosol particles in assessing the climate impacts is the formation of contrail cirrus clouds from black carbon (BC) emitted at aircraft cruising altitudes. In the method for measuring non-volatile particles (assumed to be equivalent with BC) from turbofan engines, a volatile particle remover (VPR) heated to 623 K is generally used to vaporize volatile compounds such as sulfate and organics. Tetracontane (n-$C_{40}H_{82}$) is used as a test compound for evaluating the removal efficiency of volatile particles in VPRs. Recent studies showed that the formation of nanoparticles from jet engine lubrication oil could be an important source of aerosol particles in aircraft emissions under real-world operating conditions (e.g., Fushimi et al. Atmos. Chem. Phys., 19, 6389-6399, 2019). The volatility of nanoparticles composed of jet engine lubrication oil has not been well characterized. The purpose of this study is to investigate the volatility of nanoparticles generated from unburned jet engine lubrication oil (Mobil Jet Oil II) and compare it with those from triacontane (n-$C_{30}H_{62}$) and tetracontane. The particle number fraction remaining downstream of a custom-made evaporation tube was measured for particle diameters of 30 and 50 nm. The temperature of the evaporation tube was varied from room temperature to 673 K, and the temperature dependency of the particle number fraction for jet engine lubrication oil, triacontane, and tetracontane particles was investigated. The results from the laboratory experiments were used for the interpretation of the volatility of aircraft exhaust particles under real-world operating conditions observed at Narita International Airport.

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