Geophysical Research Abstracts
Vol. 18, EGU2016-8502, 2016
EGU General Assembly 2016

Vapour pressures and hygroscopicity of semi-volatile organic components in ternary organic/inorganic/water aerosol droplet trapped by aerosol optical tweezers

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Knowledge of the vapour pressures of semi-volatile organic compounds is of critical importance in determining their partitioning behaviour into atmospheric aerosol. Quantifying the gas/particle partitioning of organic compounds is of great importance since at present published results of the vapour pressures of compounds of interest (typically with vapour pressures lower than 0.01 Pa) can be different by several orders of magnitude and influences on SVOCs evaporation from participation of inorganic compounds remains unclear. In this study we present a new method for the retrieval of SVOCs vapour pressures from single aerosol droplets in an aerosol optical tweezers system. Measurements of the concentration of SVOC (derived from experimentally determined RI) and radius of SVOC aqueous droplets are correlated in an expression derived from the Maxwell gas phase diffusion equation for the determination of vapour pressure.

$$\frac{dm_i}{dt} = \frac{4}{3}\pi\left(\frac{dr^3}{dt}Conc_i + \frac{dConc_i}{dt}r^3\right) = \frac{4\pi r M_i D_{i,gas}}{RT}\left(p_{i,\infty} - p_{i,r}\right)$$

Relationship between *r dr/dt* $(nm^2 s^{-1})$ and r^2*dConcentration/dt* $(nm^2 g L^{-1} s^{-1})$ is presented, in which the slope is derived for determination of hygroscopic line whilst the axis intercept can be determined to estimate vapour pressure. Briefly the method relies on the levitation of a droplet (3-7 μm radius) in an aerosol optical tweezers system. In this system the droplet acts as a microcavity and the size and refractive index of the particle can be extracted by using Mie theory to fit the positions of the "whispering gallery modes" in the cavity enhanced Raman spectroscopy fingerprint. The vapour pressure can then be extracted from the correlation between the rate of change of particle radius with the rate of change of composition (refractive index, n). We will show that information about the hygroscopicity of the particle and how this changes as the particle evaporates can also be determined from the changing slopes of these plots.