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Investigating the Accommodation of Water and Ethanol on a Single Aqueous Aerosol Droplet

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In this work, the non-intrusive spectroscopic technique cavity enhanced Raman scattering (CERS) is coupled with optical tweezers to investigate the dynamics of micron size aerosol droplets. By trapping a single droplet, growth in droplet size and change in composition has been probed with time.

CERS occurs as a result of droplets behaving as low loss optical cavities at wavelengths commensurate with whispering gallery modes, thus providing a mechanism for optical feedback. The CERS technique enables aerosol droplet dynamics to be probed by monitoring both size and chemical composition simultaneously. Droplet size can be monitored with nanometre accuracy, alongside the evolving chemical composition, by using spontaneous and stimulated Raman scattering methods.

Optical tweezers use a microscope objective lens to focus a laser beam to an extremely tight focal waist, thus creating a three dimensional optical trap. This technique has been used to trap and manipulate aerosol droplets 4 – 14 μm in diameter over time frames of hours at trapping powers less than 10 mW. The creation of multiple optical traps has enabled droplet coagulation and the uptake of ethanol onto two water droplets simultaneously to be studied. In addition to measurements studying dynamical processes, we report trapping efficiencies for water and decane droplets and discuss the impact of droplet heating.