Impact on *VI*scosity, *R*eactivity and *A*tmospheric *L*ifetimes of *C*omplex *A*erosol *SE*lf-assembly (*VIRAL CASE*).

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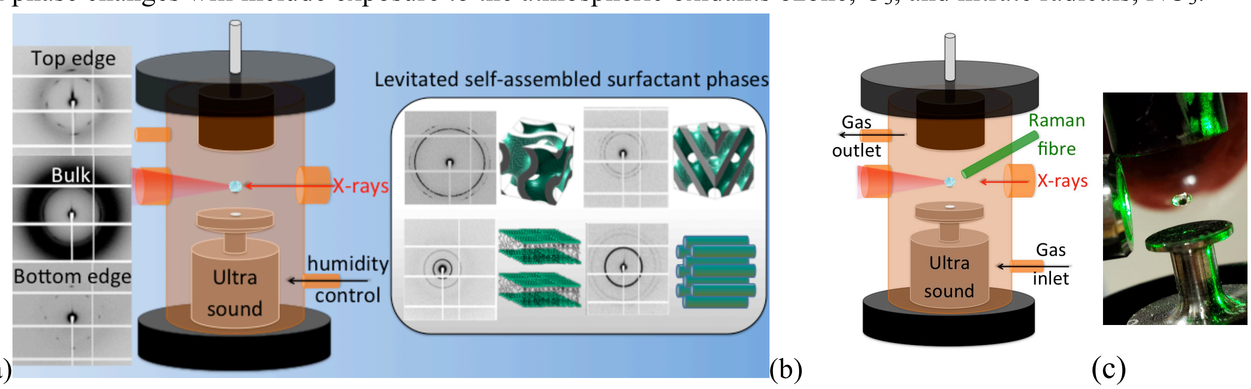
Human activities such as meat cooking lead to the emission of fatty acids and related species into the atmosphere. Surfactant molecules such as fatty acids are known to self-assemble in contact with water into a rich variety of nanostructures. These include bilayers, and spherical or cylindrical micelles or inverse micelles (water nano-spheres or cylinders surrounded by a surfactant monolayer) which themselves can be organised into periodic 1–D, 2–D or 3–D arrays. This self-assembly can vary dramatically depending on parameters such as surfactant charge, concentration, pH and temperature, and strongly affects physical properties including light scattering, diffusion, viscosity and water uptake. These properties are key in an atmospheric context, e.g. for cloud formation, radiative forcing as well as chemical reactivity and atmospheric lifetimes of organic molecules. We will investigate nanostructures formed in mixtures approximating realistic atmospheric conditions in terms of surfactant composition, acidity, temperature and humidity. The samples will be studied in different forms: "bulk" mixtures of surfactant & water; thin films mimicking layers on solid atmospheric particles; and acoustically levitated water-based droplets. We will probe the self-assembly using a technique that allows investigation of the particle structure on the nanoscale (small-angle X-ray scattering), and the reactivity, viscosity and water uptake using complementary techniques such as Raman microscopy. Time-resolved studies of phase changes will include exposure to the atmospheric oxidants ozone, O_3, and nitrate radicals, NO_3.



(a) (b) (c)

Fig. 1: (a) Key experimental approach recently developed by us (Seddon et al., *JPC Lett*, 2016; *ACS Editors' Choice* article): Raman acoustic levitator linked to X-ray scattering facility (MaxLab, Sweden) to study complex self-assembly in levitated atmospheric aerosol proxies for the first time; (b) latest experimental approach successfully combining set-up (a) with *in-situ* Raman spectroscopy to follow chemical changes in self-assembled levitated aerosol droplets; (c) image of levitated self-assembled droplet being probed by X-ray and Raman simultaneously during an ozonolysis reaction.

Training opportunities:
Integral to this project are regular experiments at large-scale facilities such as Diamond Light Source and MaxLab where tailored workshops on key tools/methods are offered; there will also be ample opportunity to contribute to modelling work harvesting the new experimental data with potential visits to the Max Planck Institute for Chemistry in Mainz, Germany (up to 2–4 weeks p.a.).

Student profile:
This project is suitable for students with a degree in chemistry, physics or a closely related physical science.

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