Liquid crystal phase formation of monoolein in protic ionic liquids

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Monoolein-based liquid crystal phases formed through lipidic self-assembly have an established media for drug delivery and membrane crystallisation[1,2]. Only solvents containing specific properties can support lipidic self-assembly, of which ionic liquids are the largest class[3]. Protic-ionic liquids are tailorable solvents which can have low melting points, and have emerging applications as solvents for biomolecules, including as protein crystallisation media[4]. While separately the roles of protic ionic liquids, lipids and liquid crystal phases have proven benefits in biological fields[5], [6], foundational knowledge of liquids crystal phases present for lipid:protic-ionic-liquid systems is lacking. In this study, the liquids crystal phase behaviour of the lipid monoolein was investigated in a series of 6 protic ionic liquids known to support amphiphile self-assembly, namely ethylammonium nitrate, ethanolammonium nitrate, ethylammonium formate, ethanolammonium formate, ethylammonium acetate, and ethanolammonium acetate. The effect on monooelein self-assembly of systematic changes to the protic ionic liquid structure was conducted, including increasing alkyl chain length, presence of a hydroxyl group on the cation, and changing the anion. The liquid crystal phases were studied using synchrotron small angle x-ray scattering, paired with cross polarized optical microscopy. Utilisation of a high throughput phase identification procedure aided in discovery of hexagonal, bicontinuous cubic and lamellar liquid crystal phases in all 6 protic ionic liquid solvents, leading to the production of intricate phase diagrams for 20-80wt% monoolein in the temperature range of 25 ˚C-70 ˚C.

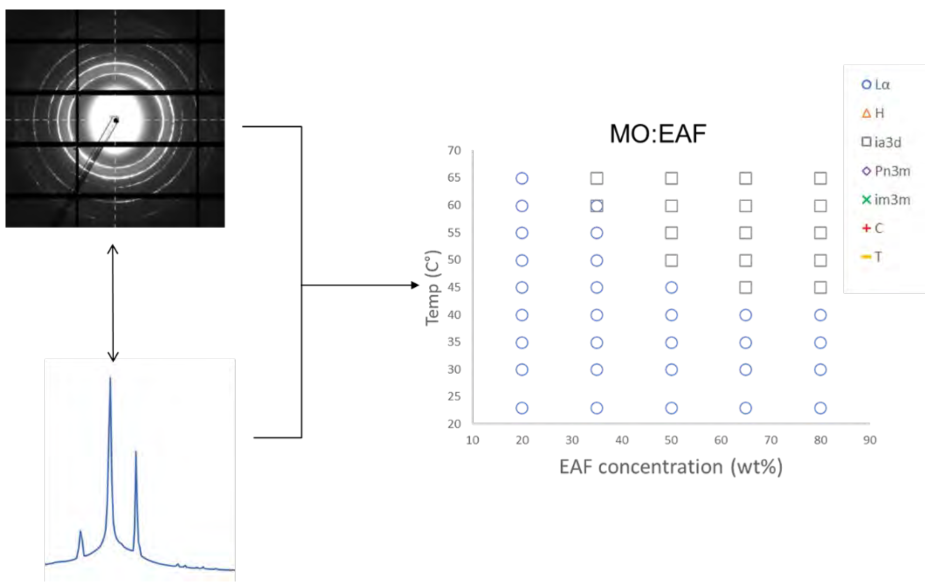

Figure 1. Example small angle x-ray scattering and 1D scattering profile, leading to MO:EAF phase diagram .

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