A Reverse Micellar Mesophase of Face-Centered Cubic Fm3m Symmetry in Phosphatidylcholine/Water/Organic Solvent Ternary Systems

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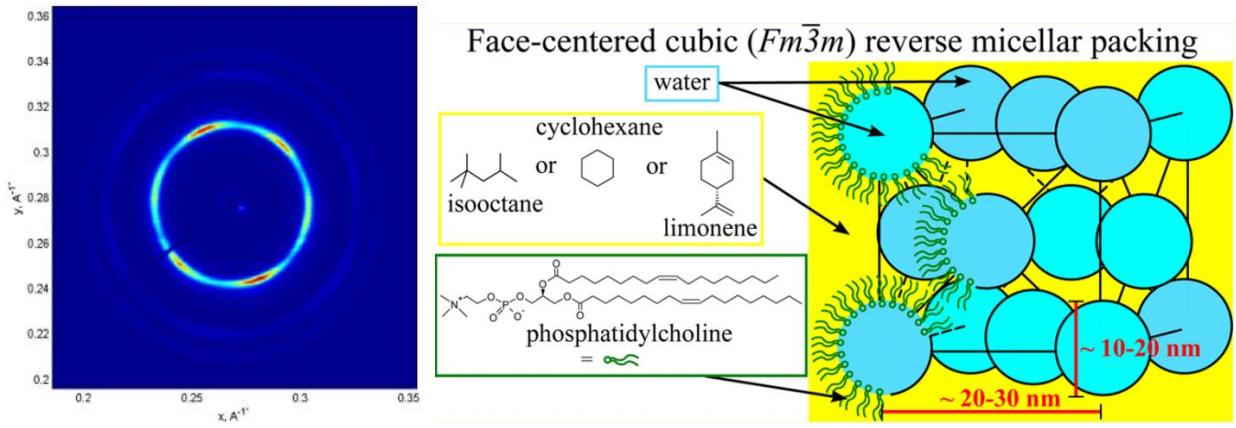
INTRODUCTION: Phosphatidylcholine (PC) forms only lamellar mesophases in water, but it can be driven to self-assemble spontaneously into nonlamellar lyotropic liquid crystalline (LLC) mesophases by the addition of a third apolar component (oil) [2].

We report the formation of a reverse micellar cubic mesophase of symmetry Fm3m (Q225) in ternary mixtures of soy bean PC, water, and an organic solvent, including cyclohexane, (R)-(+)-limonene, and isooctane, at room temperature [1]. The mesophase structure consists of a compact packing of remarkably large reverse micelles in a face-centered cubic (fcc) lattice, a type of micellar packing not yet reported for reverse micellar mesophases.

METHODS: Samples were equilibrated several weeks, and then characterized by Small Angle X-Ray Scattering (SAXS) and shear rheology. The Fm3m structure is compared with the non-compact Fd3m structure found in the PC/water/ α -tocopherol system. Form factor fitting in the pure L2 phase and in the Fm3m-L2 coexistence region yields quantitative estimations of the micellar low polydispersity and PC interface rigidity.

RESULTS: The mesophase spacegroup was identified based on spacing ratios and peak intensities. The variations of structural parameters point out to a classical hard-sphere phase diagram, showing an order-disorder transition Fm3m-L2 with an extended coexistence region. Micellar polydispersities σ/R_c were systematically below 0.2, yielding interface rigidities $2\kappa + \kappa'$ of 1.6 to 2.0 kBT.

CONCLUSIONS: The compact Fm3m structure results mainly from (1) the release of lipid tail frustration and (2) hard-sphere interactions between remarkably monodisperse micelles. The oil fills the large geometric voids of the fcc cell and modifies the interface bending properties by penetrating the PC tails.



SAXS pattern from the fcc packing in the reverse Fm3m structure in PC/water/oil systems.

References:
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