

METALLOMESOGENS AND METALLOSURFACTANTS: FROM DISCOTIC LIQUID CRYSTALS AND REDOX-ACTIVE SURFACTANTS, TO TEMPLATED MESOPOROUS MATERIALS

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In this lecture I will overview our recent work on the structure and phase behavior of metallomesogen and metallosurfactant systems, as well as briefly describing some novel recent results on more conventional thermotropic mesogens.

In collaboration with G. Yahioglu and co-workers (Imperial College London, UK), the transitional properties and structures of porphyrin-based discotic liquid crystals have been investigated by polarising optical microscopy (POM), differential scanning calorimetry (DSC) and X-ray diffraction. A homologous series of three octakis-alkyl-substituted porphyrin derivatives with alkyl chainlengths of 8, 10 and 12 were investigated. Each of the compounds was available with either free-base (i.e. two H-atoms) or fourfold co-ordinated Zn in the centre of the porphyrin. Only the metal co-ordinated compounds were found to exhibit thermotropic liquid-crystalline mesophases.

In collaboration with R. Deschenaux and co-workers (University of Neuchatel, Switzerland), a homologous series of ferrocene-containing carbohydrate surfactants has been synthesized, and they are being investigated by POM, DSC and X-ray diffraction. Our initial work on the C₁₄ chainlength surfactant [1] showed it to exhibit both thermotropic smectic phases in the dry state, and lyotropic lamellar phases upon addition of water. These redox-active liquid crystals have the potential to allow electrochemical control of the phase structure and phase behavior.

In collaboration with D. W. Bruce and co-workers (University of Exeter, UK), cationic ruthenium-based surfactants are under investigation with regard to their use in 'true liquid crystal templating' of mesoporous silicas. Our initial work showed the templated material to have a high catalytic selectivity for the hydrogenation of hex-1-ene [2]. We have now characterized in some detail the phase diagram of the dinonadecyl-substituted ruthenium complex in water, and have studied the effect of methanol (released during the condensation reaction) on the phase behaviour of the surfactant.

As part of our ongoing studies of dimeric thermotropic liquid crystals, in collaboration with C. T. Imrie (University of Aberdeen, UK) we have recently found the first example of a triply-intercalated smectic phase, where the layer spacing is close to one third the fully extended molecular length [3].

In a collaboration with G. R. Luckhurst and co-workers (Southampton University, UK), Y. K. Levine (Utrecht University, Netherlands) and W. Bras (ESRF, France), we have used time-resolved synchrotron X-ray diffraction to study the alignment of a smectic A liquid crystal phase by a 7T magnetic field [4]. The results show that the alignment behavior changes fundamentally when the sample rotation angle exceeds 45 °, and there is a sharp change in the alignment process when the temperature is less than 3 °C below the smectic A – nematic transition.

References:

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