Luminescence of metallomesogens in the liquid crystal state

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A metal center can add unique magnetic, spectroscopic or redox properties to a liquid crystal. Whereas the first examples of metal-containing liquid crystals (metallomesogens) mimicked the rodlike or disklike shape of the conventional organic liquid crystals, it gradually became clear that mesomorphism can also be observed for other coordination geometries than linear or square-planar coordination. For most of the metallic elements, at least one liquid-crystalline metal complex has been described in the literature. However, the high transition temperatures (>100 °C) and low thermal stability at these elevated temperatures of metallomesogens are major drawbacks that hamper the study of the physical properties of these materials. It is especially difficult to observe light emission (luminescence) at high temperatures because of the strong tendency of the excited states to de-activate via non-radiative transitions. Therefore most of the luminescence studies on metallomesogens that have been performed so far have been restricted to samples in the solid state or dissolved in organic solvents. However, careful design of metallomesogens on the basis of previously gained experience enables at present to obtain metal complexes that are liquid-crystalline at very moderate temperatures or even at room temperature. Thanks to this recent progress, luminescence studies of metallomesogens in the liquid crystal state are starting to appear in the scientific literature [1].

Luminescence in the liquid crystal state has been observed for metallomesogens incorporating lanthanide(III), gold(I), silver(I), copper(I) or zinc(II) ions. It should be noted that most of the emissive excited states in metallomesogens are not metal-centered, the luminescence by the trivalent lanthanide ions being the exception. As a consequence, the luminescence properties of the metallomesogens containing d-block elements are more strongly affected by the intramolecular interactions in the mesophase than those of the lanthanidomesogens. The study of the luminescence of metallomesogens in the liquid crystal state can give valuable fundamental insight in the photophysics of ordered metal-containing systems.

Another approach to obtain luminescent metal-containing liquid crystals is by dissolving a luminescent metal complex in a suitable liquid-crystal host matrix. The advantage of this method is that the luminescence and mesomorphic properties can independently be optimized.. A fascinating property of aligned mesophases of luminescent metal complexes is the ability to observe linearly polarized emission. This was first observed for nematogenic lanthanide complexes based on β-diketonate ligands [2].

References