

Design of europium-containing liquid-crystal mixtures for use in emissive LCDs

Dries Moors, Christiane Görller-Walrand, Koen Binnemans

Katholieke Universiteit Leuven, Department of Chemistry, Celestijnenlaan 200F, B-3001 Leuven, Belgium; Dries.moors@chem.kuleuven.ac.be

The principle of fluorescent displays was first proposed by Larrabee [1] at the end of the 1960s, and was later improved by Labes [2]. This type of displays disappeared from the scientific agenda since no miniaturisable UV-sources were available at that time. Recently, the concept regained interest due to the development of the UV LED [3]. In a typical fluorescent LCD, cholesteric liquid-crystalline mixtures doped with luminescent europium complexes are irradiated by UV light. An electric field can switch the LC molecules from a cholesteric (electric field off) to a normal nematic phase (electric field on). While the cholesteric phase shows strong scattering, and thus intense luminescence, the nematic phase scatters weakly. Since there is almost no absorption, the luminescence intensity is low. The liquid-crystalline solvent in our system is 5CB, doped with a chiral compound ((*S*)-(-)-4-(2-methylbutyl)-4'-cyanobiphenyl). If these systems show high quantum yields combined with a high contrast ratio, they can be used for emissive LCDs. The advantage of such displays would be operation at low voltages, cheaper production than traditional LCDs, a high brightness and a wide viewing angle.

Beta-diketones and benzocrown ethers were synthesised as ligands for the europium complexes. Tris and tetrakis(β -diketonato)europium(III) complexes have been made. To improve luminescence yields in the tris complexes, several Lewis-base adducts of these compounds were synthesised. Excitation and luminescence spectra of these compounds have been recorded. The crystal-field energy levels of the electronic $4f^6$ configuration of Eu(III) have been determined and simulated by semi-empirical calculations. The quantum yields for emission of these complexes were measured. Finally, emission spectra of these complexes in the LC system were recorded. These spectra showed exceptionally high resolution [4].

References

- [1] R.D. Larrabee, *RCA Rev.*, 1973, **34**, 329
- [2] L.J. Yu and M.M. Labes, *Appl. Phys. Lett.*, 1977, **31**, 719
- [3] R. Yamaguchi, J. Kishida, Y. Ugai, T. Izumi and S. Sato, *Jpn. J. Appl. Phys.* 1999, **38**, L652.
- [4] K. Binnemans and D. Moors, *J. Mater. Chem.* 2002, **12**, 3374.