

Bifunctional Molecular Materials: Luminescence and Liquid Crystalline Order in Octahedral Ruthenium(II) Ionic Complexes

E. I. Szerb^{a,b}, A. Bellusci^{a,b}, A. Crispini^{b,c}, M. Ghedini^{a,b}, D. Pucci^{a,b} A. M. Talarico^{a,b}

a Dipartimento di Chimica, Università della Calabria, 87030 Arcavacata di Rende (CS), Italy.

b Centro di Eccellenza CEMIF CAL-LASCAMM Unità INSTM della Calabria, Università della Calabria, 87030 Arcavacata di Rende (CS), Italy.

c Dipartimento di Scienze Farmaceutiche Università della Calabria, 87030 Arcavacata di Rende (CS), Italy.

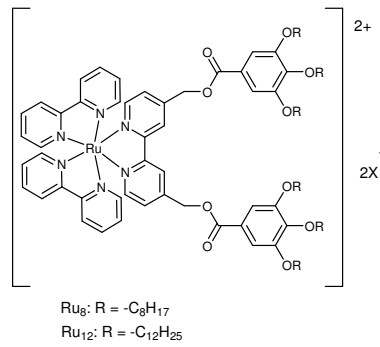
The introduction of metals in liquid crystalline systems permits the exploitation of the unique magnetic, spectroscopic or redox properties of the metal centre.¹ Metallomesogens are intrinsic multifunctional materials, representing a promising strategy of development in several technology areas from medicine, to chemistry and physics. The overall properties of the macroscopically ordered soft structures are sometimes quite different than the particular properties of the single molecular unit. A property arising from a particular functionality can be enhanced or positively modified. Therefore, studies are needed to understand the correlation between molecular structure, organisation, and the properties of the resulting structure. The major drawback of the metallomesogens are the high transition temperatures and low thermal stabilities, encountered most often for high coordination number metal complexes. Nevertheless, by a careful molecular engineering, using suitable promesogenic ligands it is possible to induce room temperature mesomorphism even for the intricate and bulky derivatives of high coordination metals.

Ruthenium (Ru) complexes have imposed themselves in the field of photoresponsive molecular electronics in particular obtained with polypyridyl derivatives.² On this background, we considered an interesting approach to obtain highly ordered thermally stable systems using as building blocks properly functionalised ruthenium complexes. Due to their bulky three-dimensional volume, ruthenium metal ions are challenging molecular objects for introduction into thermotropic liquid crystals.

Hence, in an attempt to combine two useful properties, liquid-crystallinity and luminescence, into a single multifunctional material, we employed two versatile promesogenic 4,4'-disubstituted 2,2'-bipyridine ligands as building blocks for the synthesis of new mesogenic octahedral cationic ruthenium complexes. The complexes are of general formula $[(bpy)_2Ru(C_n-bpy)^{+2}](X)_2^-$ where bpy = 2,2'-bipyridine and C_n -bpy = 2,2'-bipyridine symmetrically substituted in 4,4'-position (n = 8 and 12). Their chemical structure is presented in Scheme 1. The resulting complexes exhibit low temperature columnar mesomorphism, the stability and respectively the symmetry of the mesophases depending on the type of the counterion (X). The self-organisation of the complexes into the mesophases will be emphasised and their photophysical behaviour will be presented.

References

1. P. Espinet, M. A. Esteruelas, L. A. Oro, J. L. Serrano, E. Sola, *Coord. Chem. Rev.* **1992**, *117*, 215; K. Binnemans, *J. Mater. Chem.* **2009**, *19*, 448.
2. R. C. Evans, P. Douglas, C. J. Winscom, *Coord. Chem. Rev.* **2006**, *250*, 2093; M. K. Nazeeruddin, M. Grätzel, *Structure and Bonding*, **2007**, *123*, 113.



Scheme 1. Chemical structures of the ruthenium complexes.