PHOTOLUMINESCENT MICROPOROUS LANTHANIDE SILICATES AND METAL-ORGANIC FRAMEWORKS

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In the nanotechnology era, although the 'conventional' areas of application of zeolites will remain important, microporous solids will find uses in new fields such as optoelectronics.
In the early nineties of the last century, zeolite-type silicates built up of transition-metals (mostly Ti) heteropolyhedra, were developed [1]. By the turn of the century, the constituent elements of heteropolyhedral silicates were extended to lanthanides (Ln) and, thus, photoluminescence properties became available [1-3]. The work in the field of 'bright zeolites' culminated with the reports of: (i) an intriguing chiral system $Na_3[(Y,Ln)Si_3O_9]\cdot 3H_2O$ for which it was shown that Eu^{3+} photoluminescence spectroscopy with excitation by unpolarised light in the absence of an external magnetic field is able to identify enantiomeric domains in chiral frameworks [4]; and (ii) $K_7Eu_3Si_{12}O_{32}\cdot 3H_2O$, which possesses isolate Eu^{3+} centres and Eu^{3+}—Eu^{3+} dimers and exhibits a remarkably long emission $^5D_0$ lifetime of *ca.* 12 ms at 10 K.

With the turn of the century there was a surge of activity on inorganic-organic hybrid solids known as coordination polymers or metal-organic frameworks (MOFs). These materials are of considerable interest because the combination of inorganic and organic fragments produces a large number of new crystal architectures and allows the design of solids with specific functions. Interesting properties which may lead to industrial applications include gas storage and separation, catalysis, guest-exchange and sensors based on optical and magnetic properties. So far, only 10% or so of MOFs are effectively microporous and exhibit zeolite-type behaviour. In particular, very little work is available on microporous photoluminescent MOFs [5,6]. Recently, in collaboration with Corma's group in Valencia, we reported a new family of magnetic nanoporous MOFs whose quantum yields and efficiencies are the highest reported for solid-state Eu^{3+} compounds with organic ligands. An ethanol sensor based on the variation of the fluorescence signal at 619 nm was developed [7].

In this talk I shall show the kaleidoscopic opportunities to engineer photoluminescent centres offered by lanthanide-based microporous silicates and inorganic-organic hybrid MOFs.

References:

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