Materials Chemistry and Light

The generation and manipulation of light have played a central role in the evolution of mankind, and applications of lighting („emission“), signaling („detection“) and decoration with colours („absorption“ and „scattering“) have been developed in all cultures. In the scientific world, this fascination has been refueled in the last decade through the advent of solid state lighting, new diagnostic and therapeutic tools in the life sciences, and the availability of inexpensive laser light sources for the full range of wavelengths, from the vacuum ultraviolet to the mid infrared region. In consequence, there is now a large and very active research community either working on the integration of light sources and light modulators into ever smaller, eventually nanoscopic structures, or investigating new concepts of light generation and application. This themed issue of *Zeitschrift für Naturforschung B – Chemical Sciences* is a collection of original research articles mainly from the field of light generation (emission) and tries to give an up-to-date account of research directions in this field.

Crucial prerequisites for fine-tuned light generation from various energy sources are a diversity of specific emitters, often transition metals or lanthanide ions, embedded into synergistic matrices, like inorganic and polymeric hosts, or into cooperative ligand assemblies that yield exploitable complexes. Controlling the interaction between guests and their ambiance is decisive to grant light emission of high efficiency, and therefore a range of contributions to this issue is concerned with this very aspect. In view of stability issues, the majority of hosts is still of inorganic nature, mostly crystalline, sometimes amorphous. There is a clear trend to more complex host materials (targeting special excitation conditions or smaller band gaps), or to a more dense matrix (especially when scintillation is the envisaged application). In this context, Srivastava *et al*. report on the properties of emitting Mn^{4+} ions in complex perovskites containing tellurate units, whereas Schleid *et al*. discuss the luminescence of lanthanide ions in a tellurite- based host. A quite dense system is the material reported by Bettinelli *et al*.: Pr^{3+} is built into a matrix that essentially is a lutetium phosphate. An interesting alternative to these mostly powder-like materials is the use of transparent ceramic hosts, as reported by Waetzig *et al*. in their contribution on an aluminate system doped with Eu^{2+} as the emitting ion. A ceramic structure is also discussed in the contribution by Zych *et al*., but in this case with the background of a storage phoshor. There is also recent interest in the related phenomenon of persistent luminescence, as laid out by Hölsä *et al*. in their work on the afterglow of Eu^{2+} in alkaline earth disilicates. Chemical tuning of the host properties is possible in a broad range of oxometallates; Jüstel *et al*. as well as Guzik *et al*. present advances in this area for lanthanide ions doped into molybdate host structures.

A different approach is taken for “soft” hosts: in polymers or sol-gel systems, the emitting units often need to be preformed, be it in the form of luminescent complexes, or in the form of nanoparticles. Polymer-based approaches are described in the contributions by Kynast *et al*. for the case of a silicone matrix and by Bredol *et al*. for poly(methyl methacrylates) (PMMA); sol-gel-based examples are discussed by Gutzov *et al*. as well as by Reisfeld, the latter article being also concerned with a typical application, namely the realisation of waveguides from sol-gel-based precursor systems.

The last section of the special issue deals with the design of luminescent complexes, ranging from a systematic discussion of various lanthanide systems in the contributions by Brito *et al*. and Pietraszkiewicz *et al*. to the description of new ligands (Müller-Buschbaum *et al.*) and approaches to synthesize complexes in the form of nanoparticles (Feldmann *et al*.). Careful tuning of the chemistry of such complexes allows for chemical and physical coupling, *e. g.* with quantum dots, as demonstrated by De Cola *et al*. through the observation of bidirectional energy transfer.

Summarizing, the contributions in this special issue show that the art of preparing emitting units and systems tailored to specific matrices, specific excitation sources and various emitting wavelengths has come a long way and yet still holds great potentials. In short: Dealing with light remains a fascinating challenge for materials chemistry in all its facets.

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