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Chromic soft crystals based on photofunctional metal complexes

M. Kato

Department of Applied Chemistry for Environment, School of Biological and Environmental Sciences, Kwansei Gakuin University, Sanda, Hyogo 669-1330, Japan
katom@kwansei.ac.jp

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Various chromic phenomena such as thermochromism, photochromism, mechanochromism, and vapochromism have fascinated researchers for long time. Particularly, chromic crystalline materials are important to investigate the mechanisms structurally. Using organic and metal-complex crystals, interesting chromic materials that exhibit color and luminescence changes in response to various stimuli such as light, heat, and vapor have been developed. However, the studies that link chromic phenomena with structural dynamics were limited. To challenge the subjects, our group has focused on such chromic crystalline materials as soft crystals [1]. In this presentation, I focus on the recent progress in our studies on photo- and multi-functional metal complexes that exhibit remarkable color and luminescence changes [2-8].

Self-assembled systems of Pt(II) complexes bearing aromatic ligands have attracted much attention because of their assembly-induced luminescence based on the Pt···Pt interaction. They are also expected to be sensitive to the environmental conditions such as temperature, pressure, and vapor. We have succeeded in the constructions of a series of Pt(II)-NHC complexes (NHC = N-heterocyclic carbenes) that exhibit intense red-blue luminescence based on the assembled structures [4]. In addition, vapochromic luminescence changes based on the reversible single-crystal-to-single-crystal transformation were achieved for a weakly stacked system (Figure 1) [5]. Using weak intermolecular interactions, we have further developed a new type of stacked systems of Pt(II) complexes that exhibit assembly-induced luminescence.

Meanwhile, our group also focused on anionic Pt(II) complexes to control the molecular assembly using counter cations [6-7]. Here, the control of luminescence properties of anionic cyclometalated Pt(II) complexes by the cations will be also discussed. For example, thermo- and mechano-triggered luminescence ON-OFF switching of the luminescence has been achieved by using a Pt(II) complex ionic liquid with a phosphonium cation [7]. The characteristic properties are derived from the phase transition between highly luminescent crystal state and non-luminescent super-cooled state.

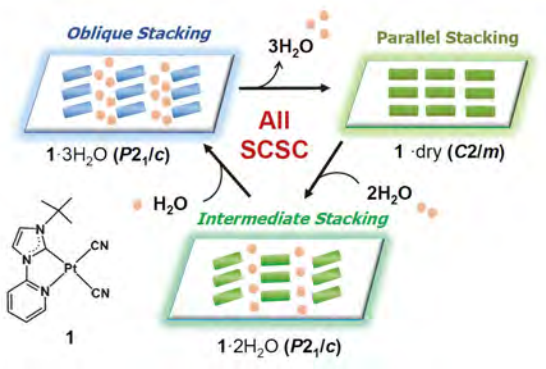

Figure 1. Reversible SCSC transformations of a vapochromic luminescent Pt-NHC complex [5].

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