

Aggregation-Controlled Luminescence in Mesogenic Gold Complexes in the Solid and Liquid-Crystalline Phases

Osamu Tsutsumi

Department of Applied Chemistry, College of Life Sciences, Ritsumeikan University,
1-1-1 Nojihigashi, Kusatsu 525-8577, Japan. E-mail: tsutsumi@sk.ritsumei.ac.jp

Organic materials showing strong luminescence in the condensed phase have attracted great interest in view of their potential application toward light-emitting devices. In general, however, the luminescence of such materials is strongly reduced in the condensed phase because of the aggregation-caused quenching effect; namely, luminescence is quenched by the aggregation of luminescent organic molecules, preventing them from being used in practical devices. Recently, materials showing aggregation-induced emission (AIE) have been developed, whereby materials exhibiting AIE properties show enhanced luminescence *via* molecular aggregation in the condensed phase.

Gold complexes are known to exhibit strong photoluminescence in cases of intermolecular interaction between Au atoms; that is, luminescence generated by these complexes is enhanced by molecular aggregation in the condensed phase.¹⁻⁴ For this reason, gold complexes have emerged as promising candidates for AIE materials with potential applicability to practical devices. In addition, the properties of the luminescence derived from gold complexes are structure-dependent such that colour and/or intensity can be manipulated by control of aggregate structure. So far, several types of liquid-crystalline (LC) gold complexes have been developed with the aim of controlling their aggregate structure.³⁻⁴ Some useful characteristics of LCs that lend themselves to efficient aggregate control include their self-assembled nature, fluidity, and responsivity to external stimuli. In this study, we examine the aggregation and photoluminescence behaviours of gold complexes in both crystalline and LC phases, providing a discussion of the relationship between the aggregated structure and luminescent properties.

Our strategy toward molecular design to provide a strong intermolecular interaction for facile formation of molecular aggregates was the introduction of simple and non-bulky ligands onto the gold atom to suppress the effects of steric hindrance. Thus, we synthesised Au(I) complexes having isocyanide and chlorine atom as ligands (Fig. 1). The luminescence intensities of the complexes were enhanced in the condensed phase. The luminescent properties were strongly affected by the aggregated structures of the complexes. A reversible “on-off” switching of the luminescence induced by the phase transition between LC and isotropic phases was demonstrated. Moreover, some complexes showed thermochromic photoluminescence controlled by the aggregated structure; the luminescence colour could be reversibly controlled by the phase transition between crystalline and LC phases (Fig. 2).

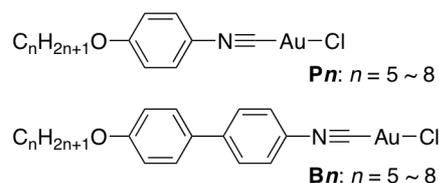


Fig. 1 Structures of gold complexes used in this study



Fig. 2 CIE chromaticity diagram for the photoluminescence of **P6** in crystalline 1 (□), smectic C (▽), and crystalline 2 (☆) phases.

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