Guest Editorial

Frontier topics in gold chemistry

The applications of gold and gold compounds in various fields have been increasing in recent decades. For instance, the anticancer and antimicrobial properties of gold compounds and the utilization of gold nanoparticles in DNA diagnostics have been the recent foci in biomedical studies and applications, while the development of gold nanoparticles attached to metal oxide and activated carbon supports as catalysts represents another prosperous field of research and have found applications in various aspects, such as in green chemistry and numerous chemical processes. There has also been a fast growing interest in the use of molecular gold complexes in gold-catalyzed organic reactions.

In addition to the well-known applications of gold compounds in the biomedical and catalysis sectors, the exploration of luminescent gold complexes has also been one of the foci of research in the field of gold chemistry in recent decades. One of the most probable reasons for the surge of the number of research related to luminescent gold complexes is the presence of weak attractive forces between two gold(I) metal centres. This non-covalent interaction is dispersive in nature and has been termed "aurophilicity" by Schmidbaur in the 1980s. Since the gold(I) centre is isolobal with hydrogen ions, analogies and comparisons between aurophilic interaction and hydrogen bonding have drawn immense interest in the scientific community. The origins of this interaction are conceived to be a result of the relativistic effects and correlation effects as proposed by Pyykkö and others through computational and theoretical studies.

The assembly of supramolecular architectures using hydrogen bonding as the driving force has been one of the most topical fields in supramolecular chemistry. In view of the similarities between aurophilic interactions and hydrogen bonding as well as the diverse coordination geometries exhibited by gold(I) complexes, the exploitation of gold...gold interactions has offered a novel strategy towards the construction of molecular assemblies. In addition to the intriguing construction of high-nuclearity clusters and supramolecular assemblies, the presence of gold...gold interactions has also led to the existence of rich polymorphism in a variety of gold compounds.

The extent of gold...gold interaction also plays a pivotal role in governing the emission characteristics of luminescent gold complexes, which has also attracted widespread attention recently. In general, a red shift in emission wavelength could be observed in the presence of aurophilic interactions. Such a lowering of the emission energy in the presence of gold...gold interactions has generally resulted from a narrowing of the HOMO-LUMO energy gap between the predominantly metal-based LUMO and the predominantly metal-based or ligand-centred HOMO. This change in emission energy could sometimes translate into visual emission colour changes that could be perceived by the naked eyes upon UV irradiation. The different polymorphs of some of the gold compounds could give rise to different absorption and emission characteristics that are mediated by the presence of gold...gold interactions. Gold-based sensory materials towards volatile organic compounds (VOCs) and mechanical pressure with luminescence changes have been reported, further demonstrating the diverse application of luminescent gold-containing complexes in the field. The perturbation of luminescence signal of dinuclear gold complexes with emissive states associated with gold...gold interactions has also been employed as luminescence probes and reporters.

Besides, the exploration of luminescent gold(III) complexes has been a recent area of research and their applications as the emissive layer or dopants in OLEDs have been demonstrated. These examples have highlighted the importance and breadth of luminescent gold complexes that could be applied in the field of optoelectronics in addition to the well-known biomedical and catalysis sectors. It is envisioned that the development of gold-based materials in optoelectronics and materials science would attract increasing attention of growing importance in the forthcoming decades.

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