Abstract

Over the past few decades an interdisciplinary approach towards the development and applications of luminescent materials has greatly enriched our knowledge owing to their diverse roles as chemo- and biosensors. This field has received renewed interests for major concerns in health hazards, national/international security issues and environmental pollution due to the advancement in globalisation and industrialisation as well as an increase rate of terrorist attacks. These concerns primarily deal with discharge of numerous toxic and harmful substances such as organic effluents (amines and ketones), nitro-explosives, toxic metal ions, volatile organic compounds, etc. into the atmosphere and aquatic systems. Thus, the luminescence-based detection, which is preferred because of its high sensitivity, fast response time, real-time monitoring, and easy portability, of these toxic substances is of vital importance and demands the design of efficient luminescent materials. Both luminescent organic and metal-organic probes have been reported for this purpose. The organic probes are based on highly π-conjugated organic moieties with signalling and recognition units, while the metal-organic probes include both aromatic organic and inorganic counterparts with functional interaction and recognition sites. The presence of different interaction sites in these luminescent materials can be utilised to detect targeted analytes with high selectivity and sensitivity.

This thesis work focused on the design and development of new luminescent organic and metal-organic probes and their sensing applications. The design of organic probes was based on the combination of (i) mixed aromatic bicyclic fused rings and Lewis basic pyridyl groups and (ii) quinoline-tagged and Lewis basic pyridyl groups. With flexible and semi-rigid spacers between the two ends of the organic probes, these were utilized for the detection of nitro-explosives at the ppm level. On the other hand, the strategic design and development of luminescent metal-organic probes was based on the combination of (i) flexible/semi-rigid bis(tridentate) and linear/bent fluorogenic dicarboxylic linkers and (ii) semi-rigid tetrapodal ligands and linear/bent fluorogenic dicarboxylic linkers. Based on their structural diversity and photophysical properties, a series of metal-organic probes was employed for showcasing targeted sensing of nitro-explosives, amines and acetylacetone pollutants at the ppm and ppb levels.