

Materials Science & Engineering Thesis Defense

Metal Ion Detection by Luminescent Metal Organic Frameworks

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abstract

Metal Organic Frameworks(MOFs) have been used in various applications, including sensors. The unique crystalline structure of MOFs in addition to controllability of their pore size and their intake selectivity makes them a promising method of detection. Detection of metal ions in water using a binary mixture of luminescent MOFs has been reported. 3 MOFs(ZrPDA, UiO-66 and UiO-66-NH₂) as detectors and 4 metal ions(Pb²⁺, Ni²⁺, Ba²⁺ and Cu²⁺) as the target species were chosen based on cost, water stability, application and end goals. It is possible to detect metal ions such as Pb²⁺ at concentrations as low as 0.005 molar using MOFs. Also, based on the luminescence responses, a method of distinguishing between similar metal ions has been proposed. It is shown that using a mixture of MOFs with different reaction to metal ions can lead to unique and specific 3D luminescence maps, which can be used to identify the present metal ions in water and their amount. In addition to the response of a single MOF to addition of a single metal ion, luminescence response of ZrPDA + UiO-66 mixture to increasing concentration of each of 4 metal ions was studied, and summarized. A new peak is observed in the mixture, that did not exist before, and it is proposed that this peak requires metal ions to activate.