INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:
Development of Functionalized Metal-Organic Frameworks for Gas Storage and Fluorescence Sensing Applications

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Thesis Submitted to the Department/ Center	:	Chemistry
Date of completion of Thesis Viva-Voce Exam	:	03.08.2017
Key words for description of Thesis Work	:	Metal Organic Framework (MOF), Fluorescence Sensing, Gas Storage

SHORT ABSTRACT

So far, a large number of MOFs have shown application potentials in gas (H_2, CO_2, CH_4, CO, etc.) storage and fluorescence sensing of a wide variety of analytes (cations, anions, biomolecules, small molecules, volatile organic compounds, nitro explosive materials, etc.). Functionalization of MOFs has been performed by using pre-functionalized ligands during the synthesis or by using the post-synthetic modification approach. The functional groups introduced in either strategy have been demonstrated to affect the physicochemical stability (air, water, acid-base, heat, etc.) as well as gas storage and separation properties of the resulting MOFs. The attached functional groups can act as interaction sites for specific gas molecules (during gas adsorption) and analytes (during fluorescence sensing), thus increasing the selectivity of the MOF material towards the target gas or analyte. In this thesis, the synthesis, characterization, gas storage and fluorescence sensing behavior of new MOFs possessing different functional groups are presented. The synthesis of air- and moisture-stable MOFs bearing desired functional groups is still a key challenge. Some of the well-known MOF materials displaying application potentials in adsorption, separation or catalysis collapse after prolonged exposure towards moisture from air. This type of instability hampers their practical applications. For enhancing their hydrolytic stabilities, hydrophobic functional groups (e.g., -F, $-CH_3$, $-CF_3$, $-OCF_3$, etc.) have been incorporated in their frameworks. In addition, the use of metal ions with higher oxidation states than divalent ions (e.g. Al(III), Cr(III), Ti(IV), Zr(IV), Ce(IV), etc.) has been demonstrated to be a successful approach, which results in MOFs having relatively higher physiochemical stabilities (air, water, heat, acid-base, etc.). In this dissertation, the gas adsorption and fluorescence sensing applications of highly stable MOFs bearing metal ions in high oxidation states (Al(III), Cr(III), Zr(IV) and Ce(IV)-based MOFs including one Cd(II)-based MOF) are presented.