

IONOTHERMAL SYNTHESIS OF ZN-BASED METAL ORGANIC FRAMEWORKS IN PYRIDINIUM IONIC LIQUID

(Sintesis Ionothermal Kerangka Logam-Organik Berasaskan Logam Zink Menggunakan Cecair Ionik Piridinium)

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Abstract

Metal organic frameworks (MOFs) are crystalline porous frameworks which have been investigated as absorbent for removing dye, metal ion, drug contaminant, and organic solvent from water. However, the traditional synthesis of MOF involves the use of organic solvents and also requires high temperature; termed solvothermal reaction. This study aimed to synthesis MOF in a rather mild condition (room temperature) using ionic liquids (ILs) instead of organic solvents. Theoretically, high ionic conductivity of cetyl pyridinium bromide ($C_{16}PyBr$) ionic liquid can develop novel MOF compounds thus, this study also aimed to investigate the possible effects of using ionic liquid in MOF synthesis. Zinc nitrate hexahydrate ($Zn(NO_3)_2 \cdot 6H_2O$) was used as the metal precursor and was reacted with the organic ligands, which is either benzene-1,3,5-tricarboxylic acid (H_3BTC) or benzene-1,4-dicarboxylate (H_2BDC), at 6:1 ratio in $C_{16}PyBr$ ionic liquid at room temperature. We hope to fabricate Zn-BDC and Zn-BTC MOFs with the same compositions, and thus recognize the effects of ILs. The powder X-ray diffraction (PXRD) and Fourier Transform Infrared Spectroscopy (FTIR) spectra of both newly synthesized MOFs showed that both Zn-BDC and Zn-BTC MOFs can be reproduced with these conditions. ILs have also been found to significantly accelerate the formation of MOFs at room temperature as the reaction time is shortened to 6 hours in IL, meanwhile the organic solvent DMF needs at least 120 hours.

Keywords: metal organic frameworks, ionic liquids, zinc, pyridinium

Abstrak

Kerangka logam-organik (MOF) adalah kerangka kristal berliang yang telah diasas sebagai penyerap untuk mengeluarkan perwarna, logam ion, bahan pencemar daripada ubat-ubatan, dan pelarut organik daripada air. Walau bagaimanapun, sintesis tradisional MOF melibatkan penggunaan pelarut organik dan juga memerlukan suhu yang tinggi; dipanggil tindak balas solvothermal. Kajian ini bertujuan untuk mensintesis MOF dalam keadaan yang agak ringan (suhu bilik) menggunakan cecair ionik (ILs) dan bukan pelarut organik. Secara teori, kekonduksian ionik yang tinggi di dalam cecair ionik piridinium bromida ($C_{16}PyBr$) boleh membangunkan perkembangan sebatian MOF yang baharu, oleh itu, kajian ini juga bertujuan untuk mengkaji kemungkinan pengaruh menggunakan cecair ionik dalam sintesis MOF. Zink nitrat heksahidrat ($Zn(NO_3)_2 \cdot 6H_2O$) digunakan sebagai pelopor logam dan di campur dengan ligan organik, sama ada asid benzena-1,3,5-trikarboksilik (H_3BTC) atau benzena-1,4-dikarboksilat (H_2BDC), pada nisbah 6:1 menggunakan pelarut cecair ionik $C_{16}PyBr$ pada suhu bilik. Kami berharap dapat menghasilkan MOF Zn-BDC dan Zn-BTC dengan komposisi yang sama, dan dengan itu dapat mengiktiraf pengaruh ILs. Pembelauan serbuk sinar-X (PXRD) dan spektroskopi inframerah transformasi Fourier (FTIR) daripada kedua-dua MOF yang di sintesis menunjukkan bahawa kedua-dua MOF Zn-BDC dan Zn-BTC boleh dihasilkan semula dengan keadaan ini. IL juga