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Solvothermal Synthesis and characterization of nanoporous Ni-Metal organic framework-74

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Abstract

A nanoporous nickel metal-organic framework-74 was synthesized by solvothermal method from 2,5-dihydroxyphthalic acid and Nickel(II) Nitrate Hexahydrate Ni(NO3)2.6H2O. The Ni-MOF-74s were synthesized through an interaction between coordinates of metal ion (nickel) and bridging ligands (2,5-dihydroxyphthalic acid). The Ni-MOF-74 were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) analysis, energy dispersive x-ray analysis (EDX) and Fourier-transform infrared spectroscopy (FT-IR).

Key words: Metal –organic framework, Nickel, solvothermal

1- Introduction

The synthesis of Metal organic frameworks with different sizes and shapes has been of interest in recent years due to their unique properties, such as surface, quantum size, catalytic and volume effects. MOFs have classified a new type of highly porous materials which can be synthesized through an interaction between coordinates of metal ions (nodes) and bridging ligands, under appropriate conditions [1]. MOFs as 3-dimensional structures exhibit various topologies along with individual properties like tunable porosity, high surface area from 1000 to 10400 m^2g^{-1}, simple synthesis routes, and adequate resistance. Owing to these possessions, these materials have been applied in different areas like adsorption phenomena [2], separation [3-5], gas storage [6-7] and drug delivery [8]. Among

MOFs crystals, Ni-MOF-74 is resulted from the reaction of divalent metal cation Ni with divergent organic ligand called 2,5-dihydroxybenzene-1,4-dicarboxylate (DBDC)[9]. Solvothermal method is performed by heating a mixture of organic linker and metal salt in a solvent system.

In this research nanoporous Ni-Metal organic framework-74s were synthesized through an interaction between coordinates of metal ion (nickel) and bridging ligands (2,5-dihydroxyphthalic acid) by solvothermal system.

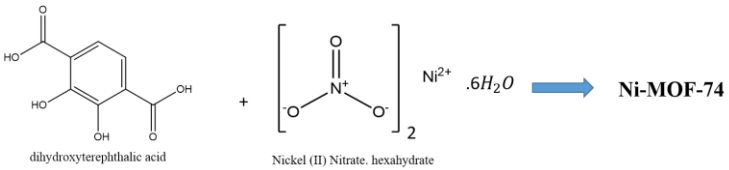

Fig. 1. Reaction dihydroxyterephthalic acid with Nickel(II) Nitrate. hexahydrate

2- Results and discussion

The FTIR spectrum of Ni-MOF-74 (fig.2) exhibits some peaks located at 1100–1200 cm^{-1},1650–1680 cm^{-1} and 1410–1450 cm^{-1} which can be assigned to stretching vibrations of epoxy C–O, C=O and aromatic C=C, respectively. Furthermore, two sharp peaks around 850–950 cm^{-1} can be assigned to the $(OH)^-$ mode, corresponding to the μ-hydroxo groups presents at the corner-sharing hexagonal units of MOF-74.

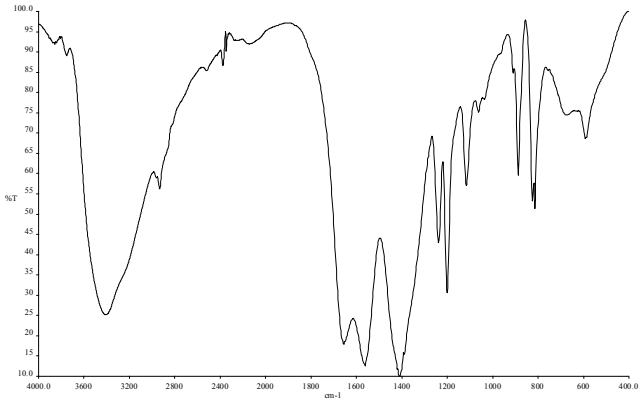

Fig. 2 The FTIR spectrum of Ni-MOF-74

The SEM images of the as-synthesized nanoporous Ni-MOF-74 is shown in Fig.
3. They were observed as a series of small spheres with a porous structure that were placed next to each other and adhered together.

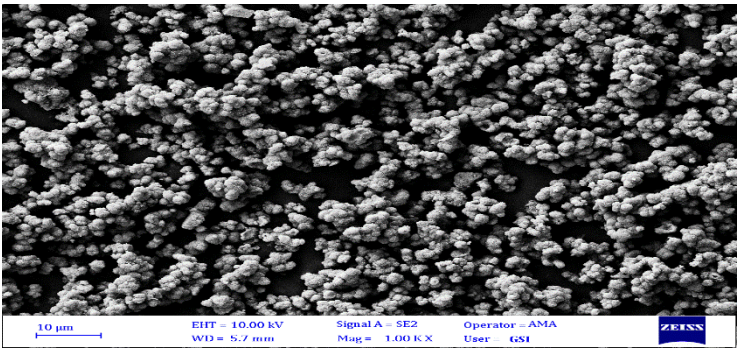

Fig. 3 The SEM images of Ni-MOF-74

An XRD pattern of the Ni-MOF-74 is shown in fig 4. In the pattern the main diffraction peaks at 7° and 12° were indexed to (110) to (300) reflections respectively that confirms its unique crystal structure.

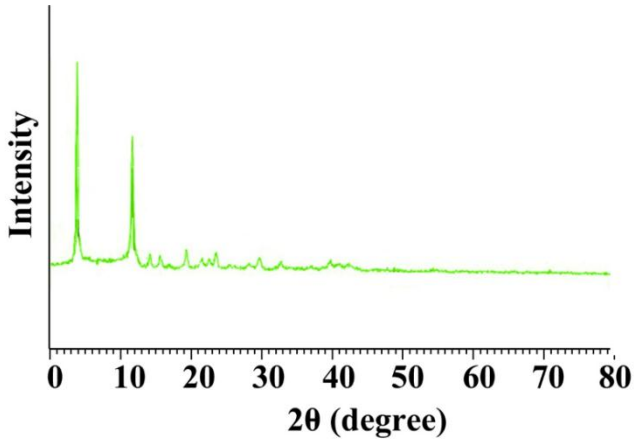

Fig. 4 An XRD pattern recorded for the Ni-MOF-74

EDX spectrum recorded for the Ni-MOF-74 (Fig. 5) showed Since MOF-74 is obtained from the reaction between of nickel cation and ligand 2,5-dihydroxybenzene-1,4-dicarboxylate, Ni, C, and O appear at 39.8%, 31.2%, and 29%, respectively.

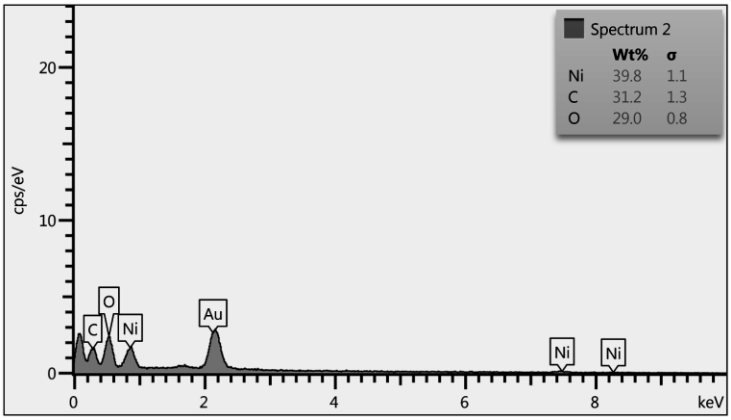

Fig. 5 EDX spectrum of Ni-MOF-74

4- Conclusion

Ni-MOF-74 were synthesized from solvothermal system. These methods often yield crystals suitable for X-ray diffraction analysis This medium led to formation of Ni-MOF-74. The employed method could be extendable to the synthesis of other shapes and sizes of MOF-74 species such as Zn, Mn, Mg(MOF-74).

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