

## Encapsulation of Nb<sub>2</sub>O<sub>5</sub> nanoparticles in ZIF for the catalysis of sodium borohydride hydrolysis

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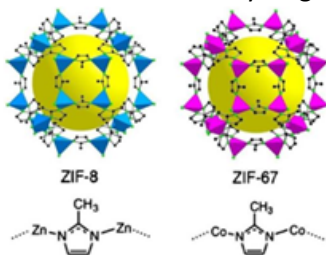
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H<sub>2</sub> can be generated from the spontaneous hydrolysis of NaBH<sub>4</sub>. Under ambient conditions, the kinetics of the process is slow; therefore, the use of catalysts can make it more efficient [1]. Different nanoparticles (NPs) supported or encapsulated in various materials can be employed as catalysts. Among these, there are Zeolitic Imidazolate Frameworks (ZIFs), a subclass of Metal-Organic Frameworks (MOFs) [2]. Thus, the objectives of this work were the synthesis of the PtNPs/Nb<sub>2</sub>O<sub>5</sub>NPs@ZIF composite and its application in the catalysis of NaBH<sub>4</sub> hydrolysis. To produce Nb<sub>2</sub>O<sub>5</sub>NPs@ZIF, Nb<sub>2</sub>O<sub>5</sub>NPs, synthesized according to Paris *et al.* (2021), were added to a solution of 2-methylimidazole in methanol. The mixture was subjected to sonication in an ultrasonic bath and then kept under constant stirring. A solution containing Zn(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O (for Nb<sub>2</sub>O<sub>5</sub>NPs@ZIF-8) or Co(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O (for Nb<sub>2</sub>O<sub>5</sub>NPs@ZIF-67) in methanol was prepared and quickly poured into the first system. After completing the stirring, the mixture was centrifuged. The supernatant was discarded, and the precipitate was washed three times with methanol [3]. The obtained powder was dried in an oven and subsequently stored for use. The deposition of PtNPs on Nb<sub>2</sub>O<sub>5</sub>@ZIF was carried out using NaBH<sub>4</sub> as a reducing agent. Our group demonstrated that the combination of Nb<sub>2</sub>O<sub>5</sub>NPs with ZIF-8 and ZIF-67 as a support for PtNPs greatly enhances the hydrolysis of sodium borohydride. The PtNPs/Nb<sub>2</sub>O<sub>5</sub>NPs@ZIF-67 composite exhibited the best reaction kinetics among the tested catalysts and a remarkable yield, indicating a possible synergy between cobalt and platinum, combined with the chemical stability of Nb<sub>2</sub>O<sub>5</sub>NPs. Therefore, the obtained results show potential application for the synthesized catalyst and good prospects for advances in hydrogen gas production.



**Fig. 1** - Schematic representation of ZIF-8 and ZIF-67. Source: Adapted from Liu *et al.*, (2021).

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