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Extraction of Amorphous SiO_2 From Equisetnm Arvense Plant for Synthesis of SiO_2/Zeolitic Imidazolate Framework-8 Nanocomposite and Its Photocatalytic Activity

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Abstract : In this work, Equisetnm arvense plant extract was used for preparing amorphous SiO_2. For preparing of SiO_2/zeolitic imidazolate framework-8 (ZIF-8) nanocomposite by solvothermal method, the synthesized SiO_2 was added to the synthesis mixture ZIF-8. The nanocomposite was characterized using a range of techniques. The photocatalytic activity of SiO_2/ZIF-8 was investigated systematically by degrading crystal violet as a cationic dye under Ultraviolet light irradiation. Among synthesized samples (SiO_2, ZIF-8 and SiO_2/ZIF-8), the SiO_2/ZIF-8 exhibited the highest photocatalytic activity and improved stability compared to pure SiO_2 and ZIF-8. As evidenced by Scanning Electron Microscopy and Transmission electron microscopy images, ZIF-8 particles without aggregation are located over SiO_2. The SiO_2 not only provides structured support for ZIF-8 but also prevents the aggregation of ZIF-8 Metal-organic framework in comparison to the isolated ZIF-8. The superior activity of this photocatalyst was attributed to the synergistic effects from SiO_2 owing to (I) an electron acceptor (from ZIF-8) and an electron donor (to O_2 molecules), (II) preventing recombination of electron-hole in ZIF-8, and (III) maximum interfacial contact ZIF-8 with the SiO_2 surface without aggregation or prevent the accumulation of ZIF-8. The results demonstrate that holes (h+) and $\bullet O_2^-$ are primary reactive species involved in the photocatalytic oxidation process. Moreover, the SiO_2/ZIF-8 photocatalyst did not show any obvious loss of photocatalytic activity during five-cycle tests, which indicates that the heterostructured photocatalyst was highly stable and could be used repeatedly.

Keywords : nano, zeolit, potocatalist, nanocomposite
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