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Synthesis of Magnetic α-Fe_2O_3/MCM-41 Composites for the Enhanced Adsorption and Stability of Aspirin

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An ideal drug carrier should fulfil a few fundamental criteria such as the ability to store large amount of drug and to ensure the adsorbed drug is stable before it is consumed. In this study, aspirin was chosen as a model drug. The stability of aspirin is easily affected by the heat and humidity of the surrounding, which would eventually lead to its degradation into acetic acid and salicylic acid.[1] On the other hand, magnetic mesoporous silica composite can be a very useful drug carrier for targeted drug delivery due to their desirable magnetic property.[2,3] Therefore, in this work, magnetic mesoporous silica (α-Fe_2O_3/MCM-41) composites with various Fe/Si molar percentages (5, 15, 25 and 35%) were prepared by direct hydrothermal and impregnation methods.

The X-ray diffraction (XRD) patterns confirmed the formation of α-Fe_2O_3 and the mesoporous network of MCM-41 on the α-Fe_2O_3/MCM-41 composites, either prepared by hydrothermal or impregnation method. Diffuse reflectance ultraviolet-visible (DR UV-Vis) spectra revealed that the absorption bands increased with the increase loading amount of α-Fe_2O_3. The adsorption capacity towards aspirin over the prepared α-Fe_2O_3, MCM-41, and α-Fe_2O_3/MCM-41 adsorbents were determined by monitoring the absorption wavelength of aspirin at 226 nm using UV spectroscopy. It was found that aspirin was unstable and converted to salicylic acid when bare α-Fe_2O_3 was used. In contrast, the hydrolysis of aspirin was not observed when MCM-41 and α-Fe_2O_3/MCM-41 composites were used as the adsorbents. As shown in Figure 1, the adsorption capacity of the MCM-41 was found to be significantly improved when the α-Fe_2O_3 was introduced into the mesoporous network. This result demonstrated the importance of both the MCM-41 support and the available Fe^{3+} ions in α-Fe_2O_3 to promote enhanced adsorption and stability of the aspirin. All of the hydrothermally prepared samples showed significantly higher amount of adsorbed aspirin as compared to the samples prepared by impregnation method. Since the hexagonal mesoporous structure of the composites prepared by hydrothermal method was better maintained than that prepared by the impregnation method, it was proposed that the ordered structure of the MCM-41 support played important role in the adsorption of aspirin.

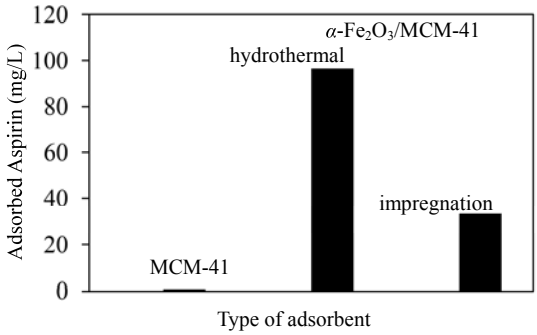

Figure 1. Adsorption of aspirin on MCM-41 and the best α-Fe_2O_3/MCM-41 samples for each series prepared by hydrothermal and impregnation methods.

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