

Improvement of laccase activity via covalent immobilization over mesoporous silica coated magnetic multi-walled carbon nanotubes for discoloration of synthetic dyes

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EXPERIMENTAL SECTION

Materials

Tetraethylorthosilicate (TEOS), Ferric chloride anhydrous ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$), ethylene glycol, sodium acetate, and ethanol of analytical grade were purchased from Tianjin Chemical Corporation. Cetyltrimethyl ammonium bromide (CTAB) was purchased from Sigma-Aldrich, Ammonium nitrate (NH_4NO_3) and glutaraldehyde (GA, 50%) were purchased from Tianjin Bodi Chemical Co., Ltd. (China). Laccase enzyme (120U/g) was purchased from Shanghai Yuanye Bio-Technology Co., Ltd (China), 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) and multiwalled carbon nanotubes (MWCNTs) with a mean diameter 5-50 nm were purchased from Aladdin Biochemical Technology Co., Ltd (Shanghai, China), Eriochrome black T (EBT), Reactive Black 5 (RB5) and Acid Red 88 (AR88) were purchased from Hubei Jusheng Technology Co., Ltd (China). All reagents were used as received without further purification.

Scanning electron microscopy (SEM) images and the photograph of magnetic separation of $\text{Fe}_3\text{O}_4\text{-MWCNTs@SiO}_2$ in water.

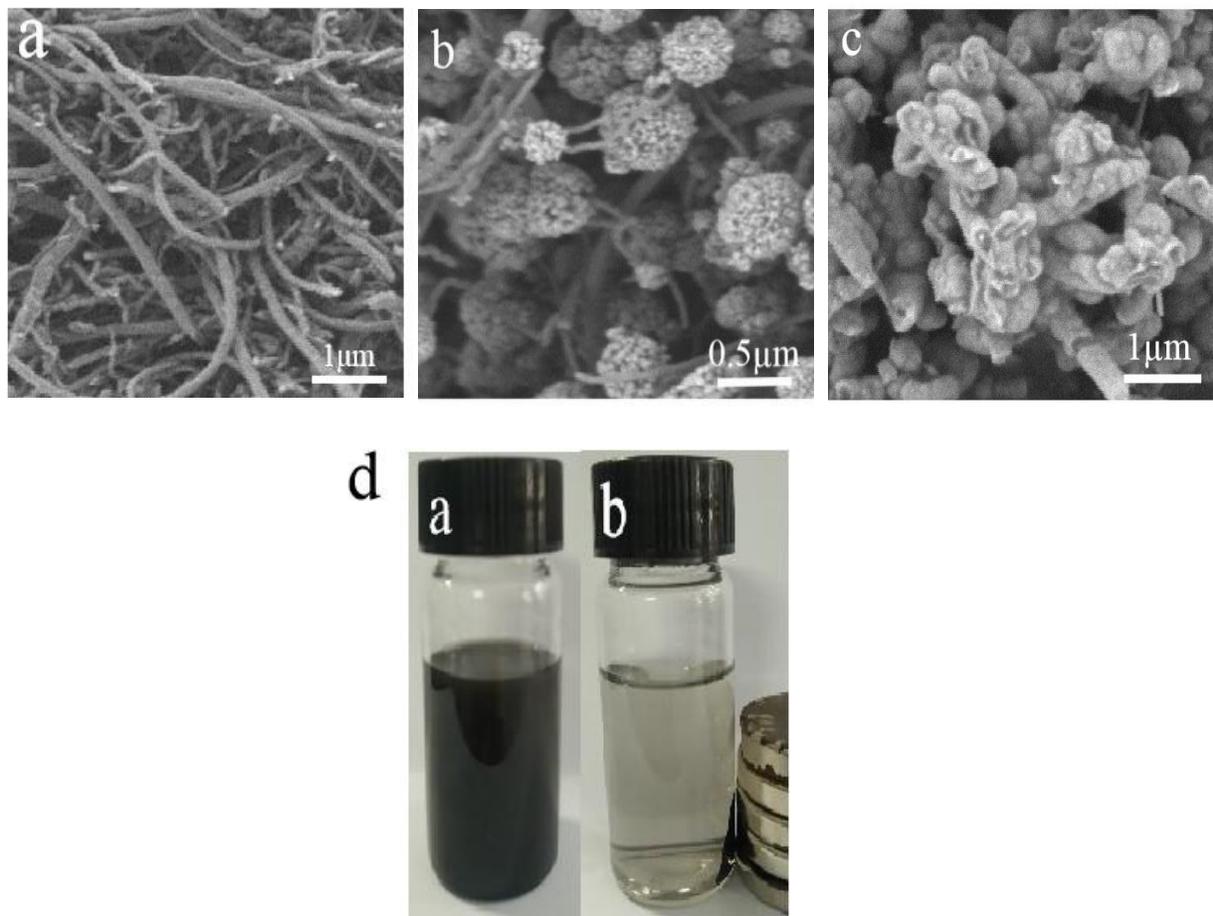


Figure S1. The morphology of obtained samples. Scanning electron microscopy of (a) MWCNTs; (b) $\text{Fe}_3\text{O}_4\text{-MWCNTs}$; (c) $\text{Fe}_3\text{O}_4\text{-MWCNTs@SiO}_2$ and (d) Photograph of $\text{Fe}_3\text{O}_4\text{-MWCNTs@SiO}_2$ solution without (a) and (b) with applied magnetic field in 10 seconds.

Energy Dispersive X-ray spectra (EDX)

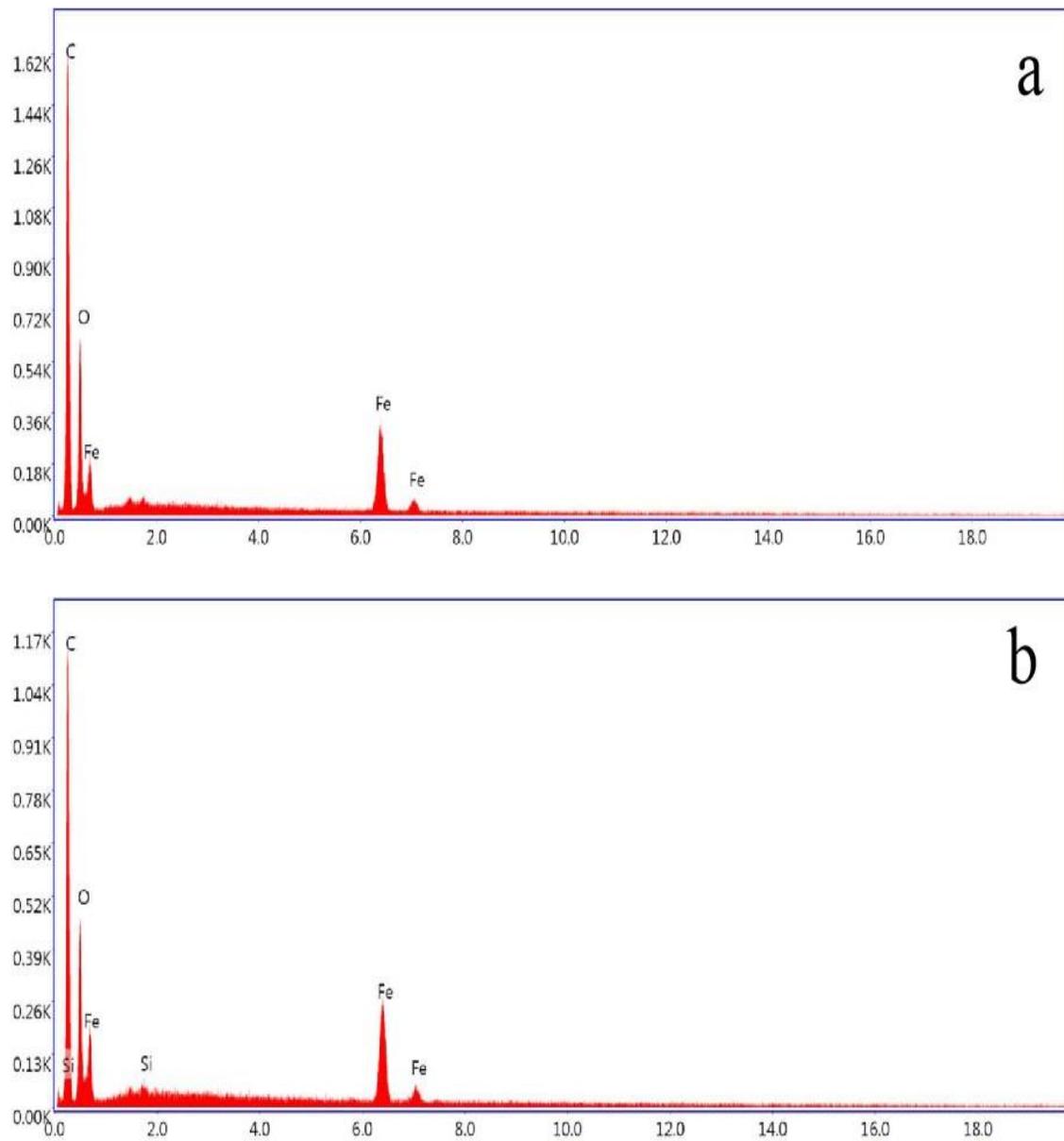


Figure S2. Energy-dispersive X-ray spectroscopy (EDX) spectrum of (a) Fe_3O_4 -MWCNTs and (b) Fe_3O_4 -MWCNTs@ SiO_2

Optimization of immobilization conditions (concentration of glutaraldehyde, activation time, concentration of enzyme and immobilization time)

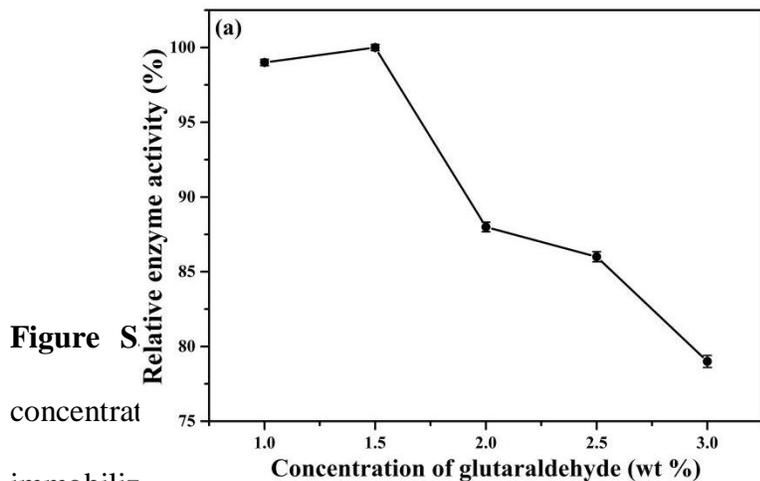


Figure S

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immobilization

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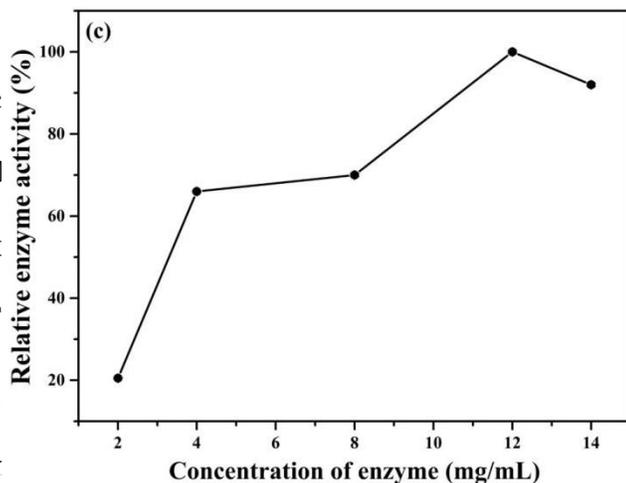
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zation. a) Effect of glutaraldehyde

enzyme concentration; d) Effect of

by hydrolyzing 2,2'-azino-bis (3-

sulphonic acid) (ABTS) as substrate under pH 4 at 25 °C for about 5 min.

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