Supporting Information

Mesoporous SiO_2 particles combined with Fe-oxide nanoparticles as a regenerative methylene blue adsorbent

Yul Hong[1]‡, Byeong Jun Cha[2]‡, Young Dok Kim[2], and Hyun Ook Seo[1]**
1 Department of Chemical and Energy Engineering, Sangmyung University, Seoul, 03016 Republic of Korea
2 Department of Chemistry, Sungkyunkwan University, Suwon, 16419, Republic of Korea

*Corresponding authors.

E-mail address: ydkim91@skku.edu (Y.D. Kim), hyun.ook.seo@smu.ac.kr (H.O. Seo)

‡Authors contributed equally to this work.

Figure S1.

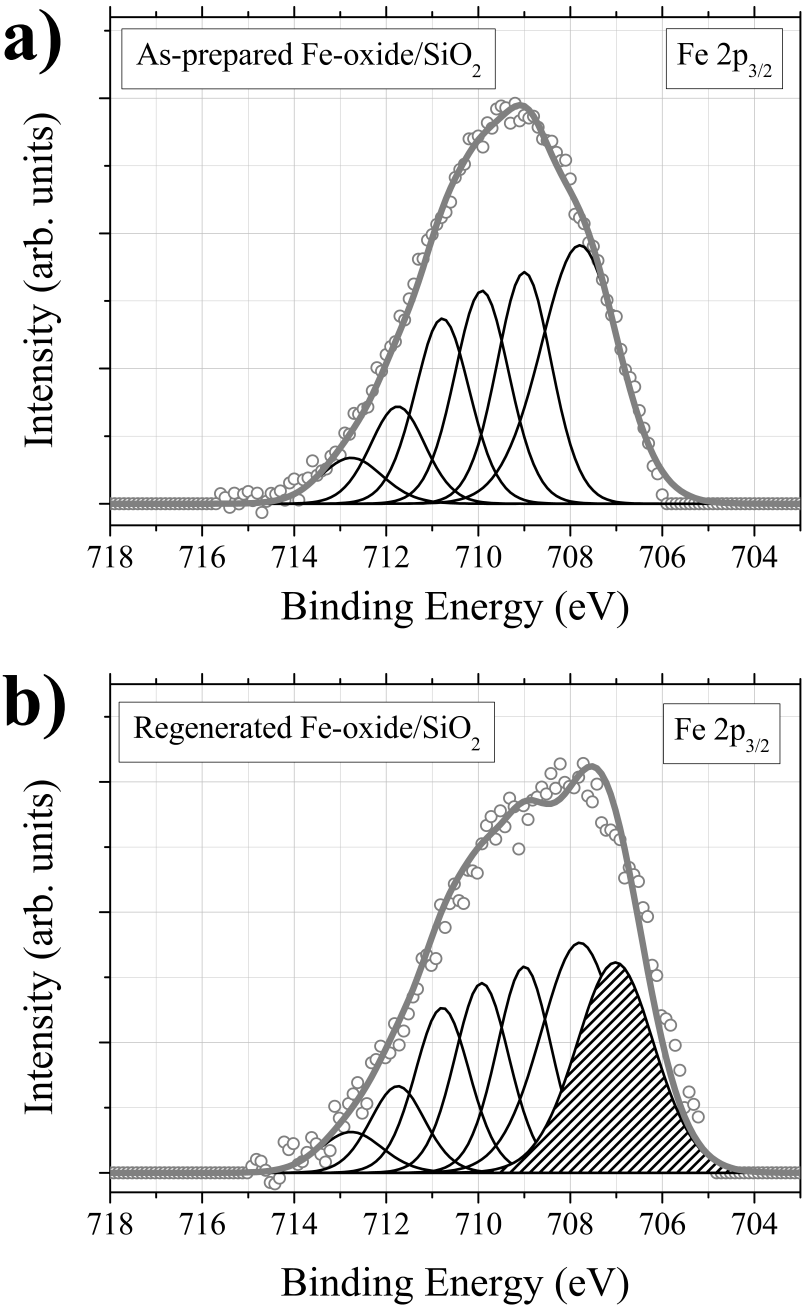

Figure S1. Fitted Fe $2p_{3/2}$ XPS spectra of a) as-prepared and b) regenerated Fe-oxide/SiO_2 particles are shown. 6 components were used to fit the Fe $2p_{3/2}$ spectrum of as-prepared Fe-oxide/SiO_2. Whereas, the spectrum of regenerated Fe-oxide/SiO_2 particles was fitted by using an additional component centered at 707 eV (filled with black line pattern) in addition to 6 components used for fitting of the spectrum of as-prepared Fe-oxide/SiO_2.
CASA XPS software was used for the XPS peak fitting. $Fe2p_{3/2}$ peak of as-prepared Fe-oxide/SiO_2 was fitted using six different Lorentzian-Gaussian mixed components after Shirley background subtraction. Only the peak intensity ratio was varied with fixed peak positions and peak width of half maximum (FWHM).). Fe $2p_{3/2}$ peak fitting of regenerated Fe-oxide/SiO_2 was done by adding one more Lorentzian-Gaussian mixed component at 707 eV as metallic Fe to six components used for the peak fitting of as-prepared sample and peak ratio among six components as well as peak position and FWHM were same as the case of peak fitting of as-prepared sample.

Figure S2.

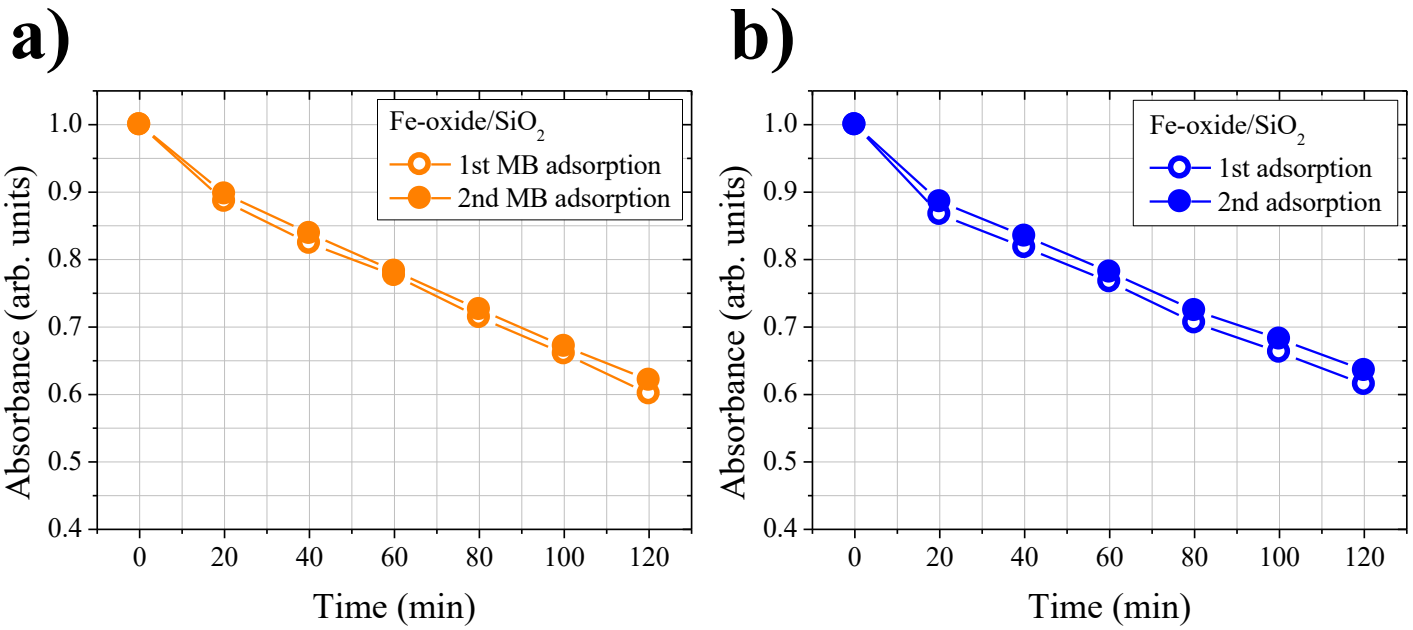

Figure S2. The absorbance changes of MB peaks (peak height at 664 nm) as a function of reaction time during 2 hrs of the 1st and 2nd MB adsorption experiments with Fe-oxide/SiO_2 particles are shown. a) The results of MB adsorption experiments conducted with Fe-oxide/SiO_2 before and after 3 hrs of thermal annealing at 200 ^oC under atmospheric air conditions as the regeneration process. b) The results of MB adsorption experiments conducted with Fe-oxide/SiO_2 before and after 3 hrs of thermal annealing at 200 ^oC under atmospheric air conditions as the regeneration process.

Figure S3.

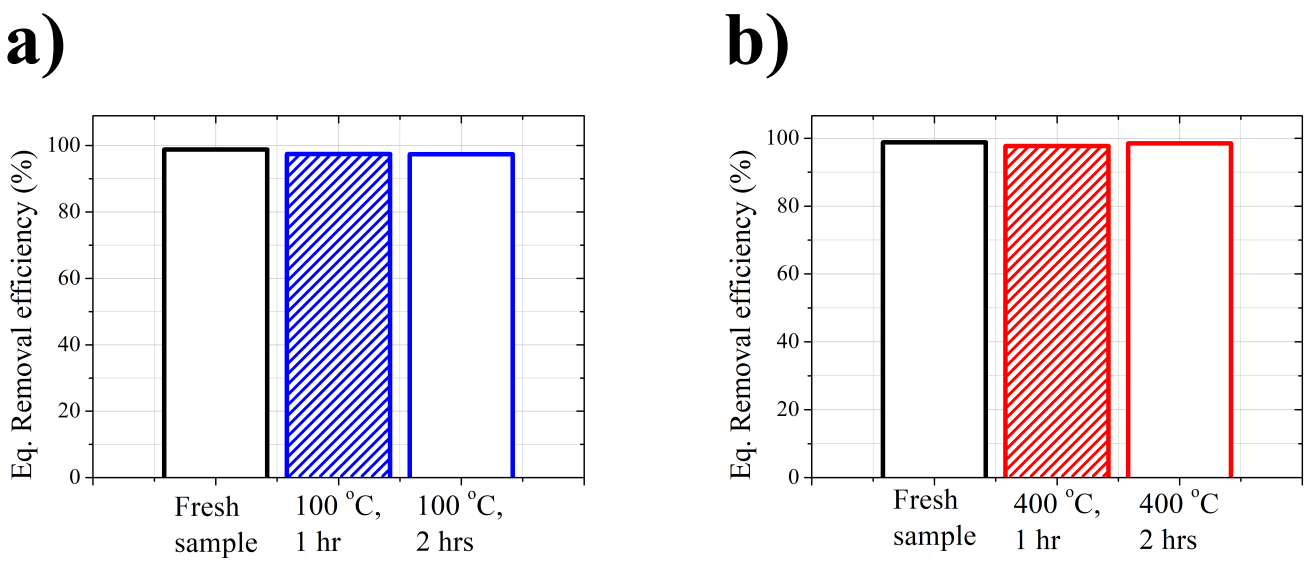

Figure S3. Equilibrium removal efficiencies of Fe-oxide/SiO_2 (Fe loading 8.3 wt%) particles measured after the regeneration by thermal annealing at a) 100 °C and b) 400 °C for decreased time duration (1 and 2 hrs) are shown. The equilibrium adsorption capacity of each Fe-oxide/SiO_2 particles was obtained after 3 hrs of MB adsorption at 20 °C and a constant shaking speed (300 rpm). 0.03 g of Fe-oxide/SiO_2 particles was placed in a vial containing 30 ml of MB solution of (10 ppm).

Figure S4.

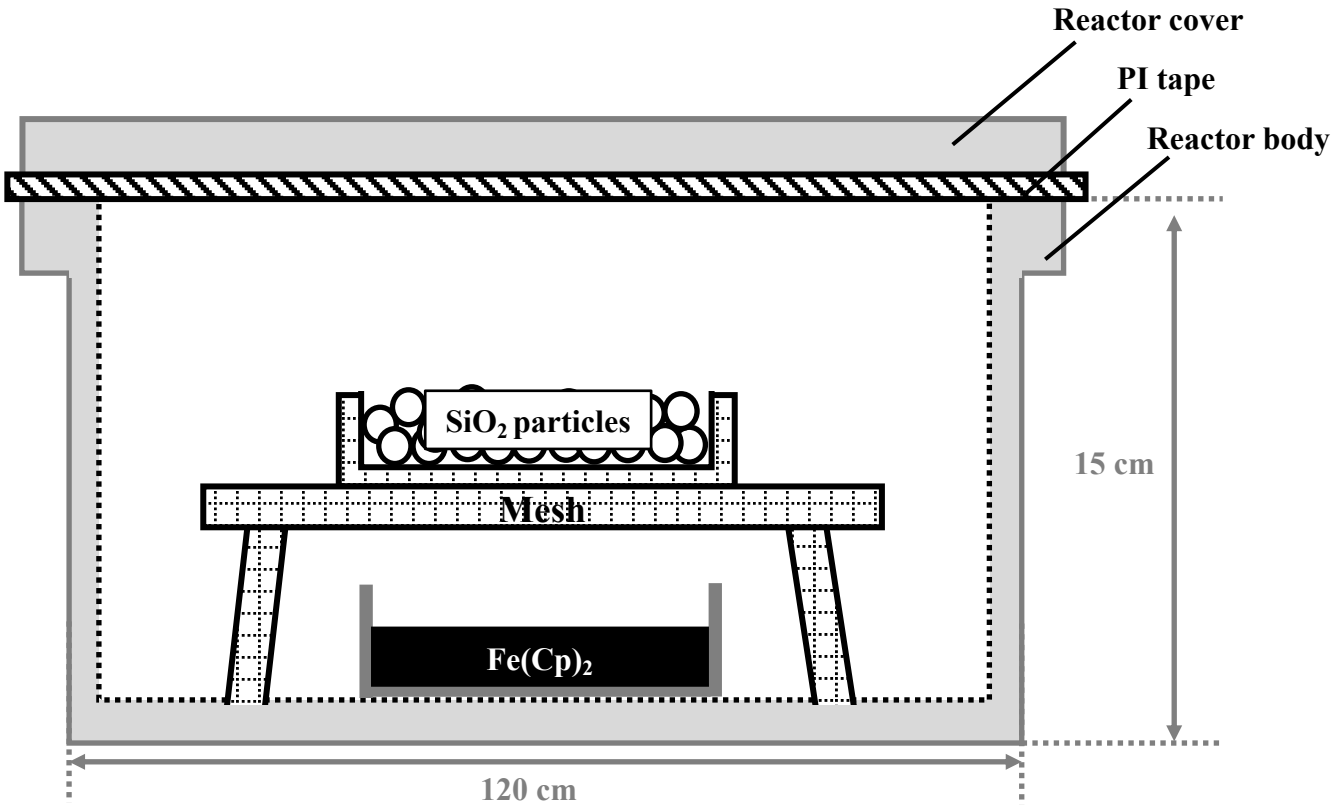

Figure S4. A schematic description of the cross-section of the reactor used for tr-CVD of Fe-oxide on SiO_2 particles is shown. 2.5 g of $Fe(Cp)_2$ in a quartz boat (internal volume of 70 x 20 x 8 mm^3) was placed at the bottom of the reactor body and 5.3 g of SiO_2 particles on a stainless steel (SUS) mesh container was placed above the $Fe(Cp)_2$. The upper part of the reactor body was closed by the reactor cover and the gap between the body and the cover was sealed with polyimide (PI) tape from the outside of the reactor. A K-type thermocouple was attached to the outside of reactor body for temperature monitoring. The outside of reactor body was wrapped by heating bands which were connected to a power supply and temperature controller.

Figure S5.

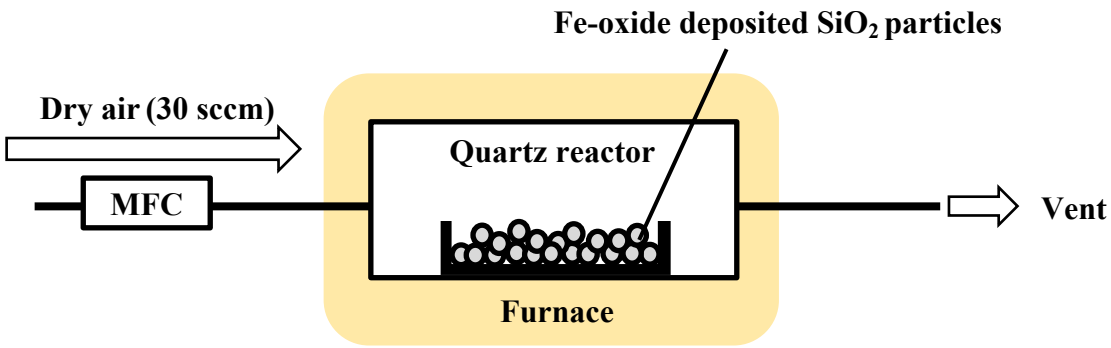

Figure S5. A schematic description of the experimental set-up used for annealing of Fe-oxide/SiO_2 particles is shown.