

**Supporting information**

**Amine modified mesoporous magnesium carbonate as  
an effective adsorbent for azo dyes**

*Maria Vall<sup>a</sup>, Maria Strømme<sup>a,\*</sup> and Ocean Cheung<sup>a,\*</sup>*

<sup>a</sup>Nanotechnology and Functional Materials Division, Department of Engineering Sciences,  
The Ångström Laboratory, Uppsala University, Box 534, SE-751 21 Uppsala, Sweden.

\*E-mail: Maria.Stromme@angstrom.uu.se, Ocean.Cheung@angstrom.uu.se

## **Experimental**

### **Infrared (IR) Spectroscopy**

IR spectroscopy was performed on a Bruker Tensor 27 instrument (Billerica, Massachusetts, USA) using a platinum ATR diamond cell. The IR spectra were averages of 128 scans.

### **Powder X-ray diffraction (XRD)**

XRD patterns were recorded using a Bruker D8 Twin Twin diffractometer (Billerica, Massachusetts, USA) with Cu-K $_{\alpha}$  radiation ( $\lambda = 1.54 \text{ \AA}$ ) for  $2\theta = 10.0$  to  $90.0^{\circ}$  at room temperature. The instrument was set to operate at 45 kV and 40 mA. Samples were washed with water several times and dried at  $70^{\circ}\text{C}$  overnight prior to measurement.

### **Nitrogen sorption**

The Brunauer-Emmett-Teller (BET) specific surface area ( $S_{\text{BET}}$ ) and porosity of the materials were determined by recording nitrogen adsorption and desorption isotherms, respectively, (at 78 K) using a Micromeritics ASAP 2020 surface area analyzer (Norcross, GA, USA). Prior to the analysis, the samples were pre-treated by heating to 373 K under dynamic vacuum ( $1 \times 10^{-4}$  Pa) using a Micromeritics SmartVacPrep sample preparation unit. Equilibrium adsorption data points were obtained when the change in pressure dropped below 0.01% within a 10 s interval (with minimum 100 s delay).  $S_{\text{BET}}$  was obtained using the BET equation for adsorption points between  $p/p_0 = 0.05$  and 0.15. Average pore size of aMMC was determined using the Density Functional Theory (DFT) methods (slit shape pore, N $_2$  model)

### **Scanning electron microscopy**

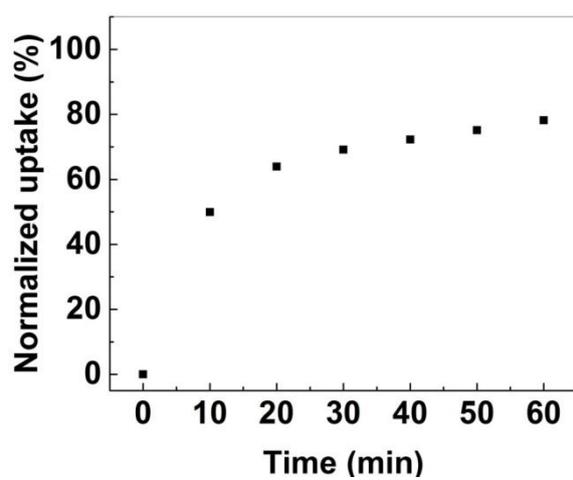
The morphology of the samples was examined using Zeiss LEO 1550 and 1530 scanning electron microscopes (Oberkochen, Germany; operated at 2kV), and an in-lens secondary

electron detector was used for imaging. Samples were first washed with water several times and dried before they were mounted on aluminum stubs with double adhesive carbon tape and sputtered with Au/Pd prior to analysis to avoid charge build up in the non-conductive materials.

## Additional data on dye adsorption

**Table S1.** Constants from three different models on uptake of AR183 onto MgO

		<b>MgO AR183</b>
<b>Langmuir</b>	$R^2$	0.9315
	$q_e$ (mg/g)	188.477
<b>Freundlich</b>	$R^2$	0.9878
<b>Sips</b>	$R^2$	0.9918
	$q_e$ (mg/g)	329.429
	n	0.324



**Figure S1.** Effect of contact time on the uptake of AR183 onto MgO

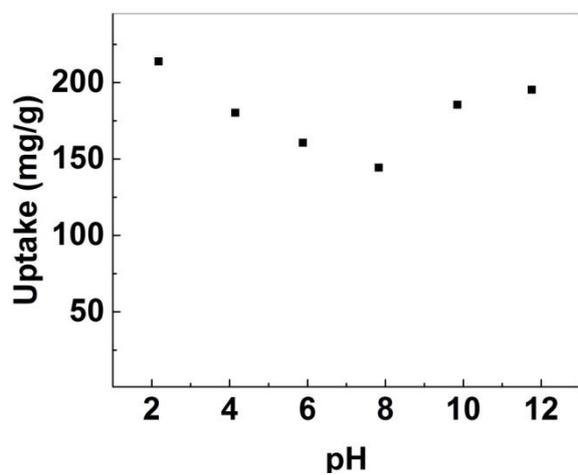


Figure S2. Effect of pH on the uptake of AR183 onto MgO

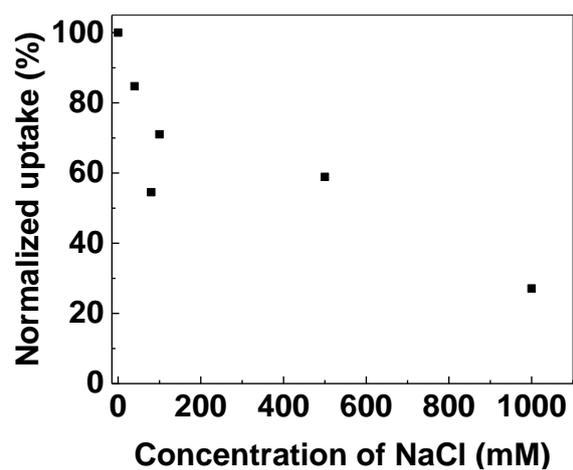
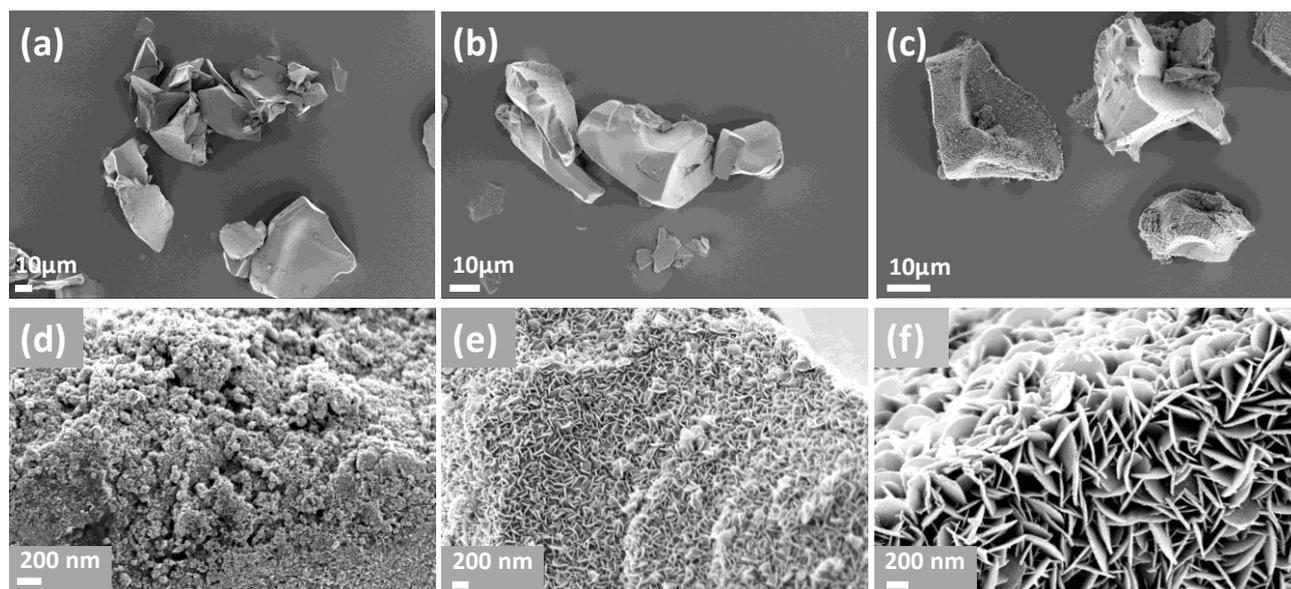
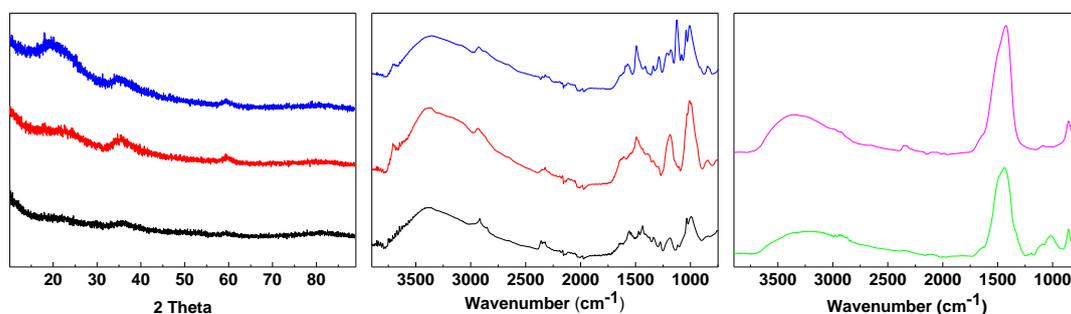


Figure S3. Effect of salt concentration on the uptake of AR183 onto MgO



**Figure S4.** SEM micrographs of aMMC after adsorption of (a,d) AM, (b,e) AR183 and (c,f) RB5. The nature of the crystals formed on the surface of aMMC was not chemically confirmed, but the IR spectra (Figure S5) show that the surface of the aMMC particle after dye adsorption was predominantly covered by organic species that were most likely to be azo dye.



**Figure S5.** XRD (left) and IR (middle) spectra of aMMC material after adsorption of (blue) RB5, (red) AM and (black) AR183. The IR spectra (recorded using an ATR in reflection mode) appeared to show that the surface of the aMMC materials was covered with the azo dye after adsorption (shown by the multiple bands in the fingerprint region  $<1500\text{ cm}^{-1}$ ). The typical IR band at  $1440\text{ cm}^{-1}$  related to the carbonate group that is present in both MMC (right, magenta) and aMMC (right, green) were no longer clearly visible, suggesting that the surface of aMMC was completely covered by azo dye.

**Table S2.** Constants from kinetic models for Adsorption of AR183 on MgO

		<b>Values</b>
<b>R<sup>2</sup></b>	<b>Pseudo-first</b>	0.9934
	<b>Pseudo-second</b>	0.9993
<b>q<sub>e</sub> (mg/g)</b>	<b>Pseudo-first</b>	93.957
	<b>Pseudo-second</b>	108.22
<b>k</b>	<b>Pseudo-first</b>	0.1016
	<b>Pseudo-second</b>	0.0013