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Supporting Information

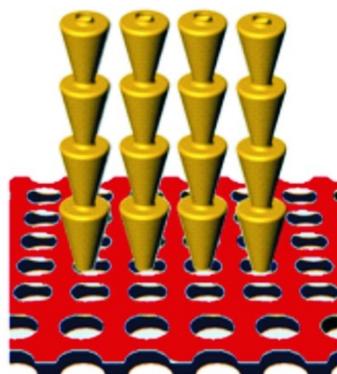
Frit free PDMS Microfluidic Devices for Chromatographic Separation and On-Chip Detection

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Losic
Group



NanoTech
Research

1) Separation and characterization of diatom silica microparticles (DE)

DE in the form of isolated and purified silica microcapsules (frustules) were obtained by multiple separation steps using our previously described procedure (1) First, solid rocks of DE mineral were pulverised for 5 sec followed by several cycles (4-5) of ultrasonication and washing with water, the full frustules were separated by collecting the heavy sedimented particles and discarding the lighter suspended particle. Thus obtained full DE frustules were washed in milli-Q water and dried in the oven. Scanning electron microscopy (SEM) and laser scattering were used to determine the size and morphology of DE microparticles used in this study.

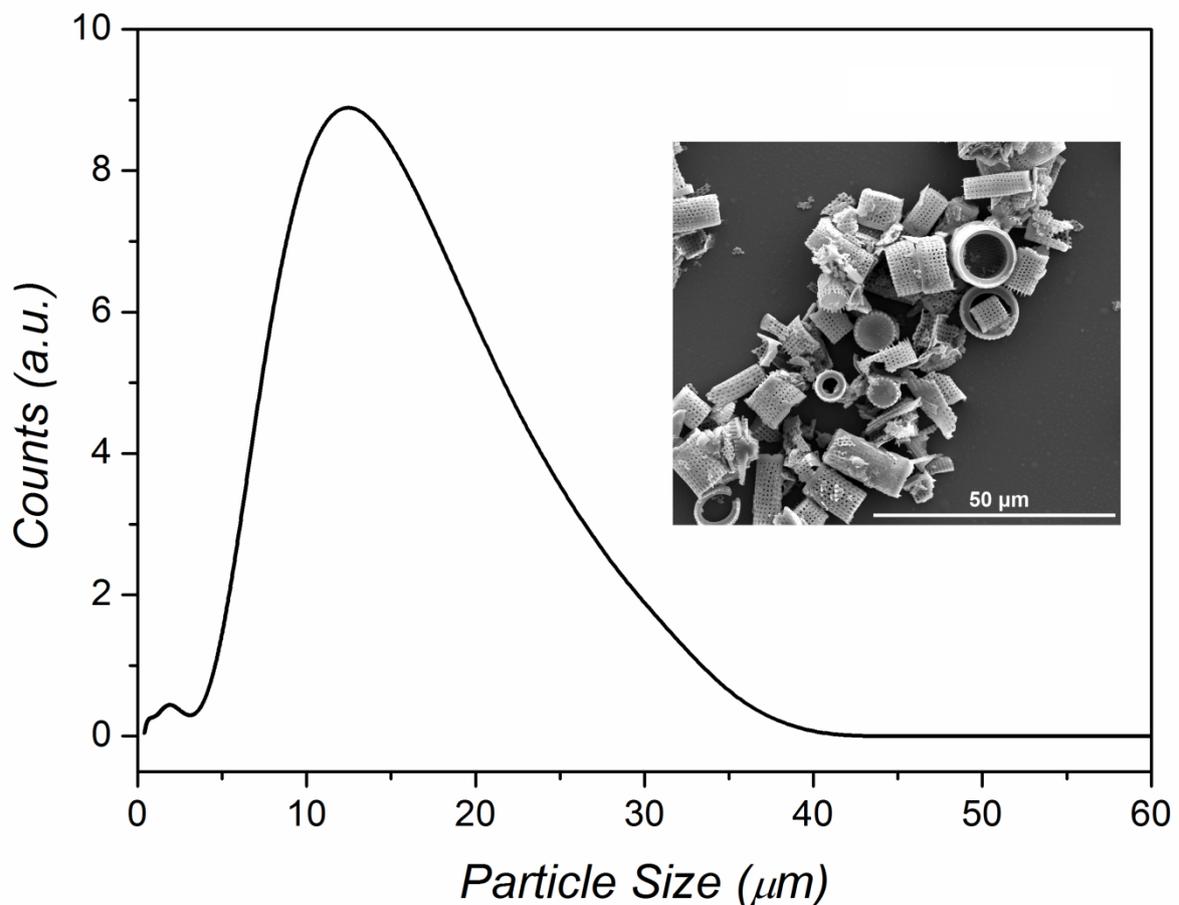


Fig. 1S Particle size analysis of separated and purified DE microparticles showing major portion of particles are around 10-12 μm range with inset showing the SEM image of the same sample with mostly full frustules.

2) Preparation and characterization of magnetic nano-particles

Magnetic nano particles were prepared by simple citrate reduction method. Briefly, 1 mmol of citric acid (trisodium salt), 4 mmol of NaOH, and 0.2 mol of NaNO_3 were mixed in 19 mL of deionized water. The mixture was then heated to 100 °C and formed a pellucid solution. 1 mL of 2 M $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$ (2 mmol) solution was added into the mixture and the mixed solution was kept at 100 °C for 1 h. The solution was then cooled down to room temperature naturally. The magnetic NPs were separated and purified from solvent by a magnet for several times. The MNPs were characterized by transmission electron microscopy (TEM) and laser scattering which are presented in Fig. 2S.

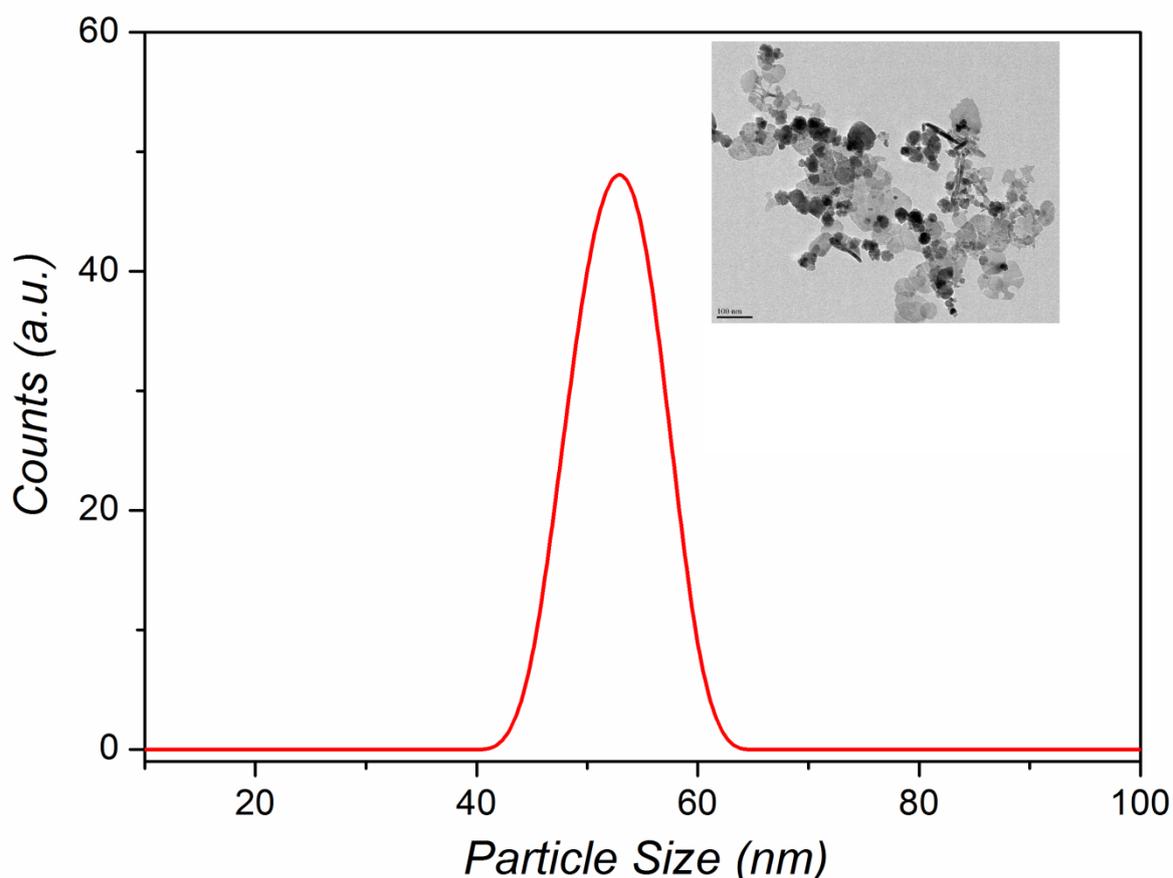


Fig. 2S Size analysis of citrate reduction based magnetic nanoparticles showing major portion of particles are around 40-60 nm range with inset showing the TEM image of the same sample.

3) Nitrogen adsorption and surface area analysis of DE microparticles

BET surface area measurements were performed with BELSorp-max, Japan. The high purity nitrogen adsorption was performed at 77 K temperature. The adsorption and desorption isotherms were fitted for BET plot by using BEL Master Software, which shows a type IV adsorption isotherm characteristic curve. In the graph, P/P_0 (P is the actual pressure in sample tube, P_0 is relative pressure of N_2 gas), is the relative pressure and V_a is the volume of N_2 the gas adsorbed.

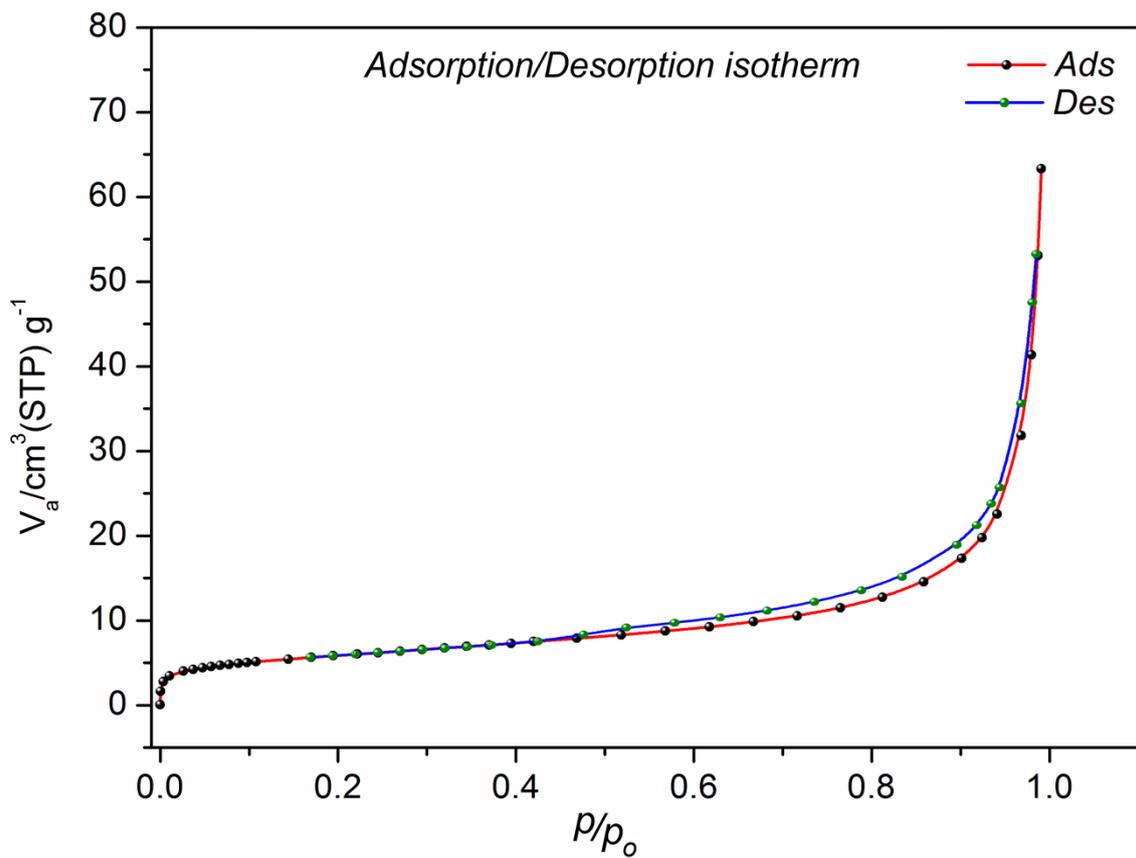


Fig. 3S BET adsorption and desorption isotherm of diatomaceous earth (DE) particles.

4) BET plot to extract surface area of DE particles

The adsorption data were fitted for BET plot by using the BEL Master software supplied with the BELSorp-max instrument: as per the theory, the initial data points were considered for the fitting, the fitting correlation coefficient was 1 with positive intercept as per the fitting requirements. The built in feature of BEL Master expelled the data for specific surface area and pore volume data. In the graph, P/P_0 is the relative pressure (P is the actual pressure in sample tube, P_0 is relative pressure of N_2 gas), V_a is the volume of the gas adsorbed.

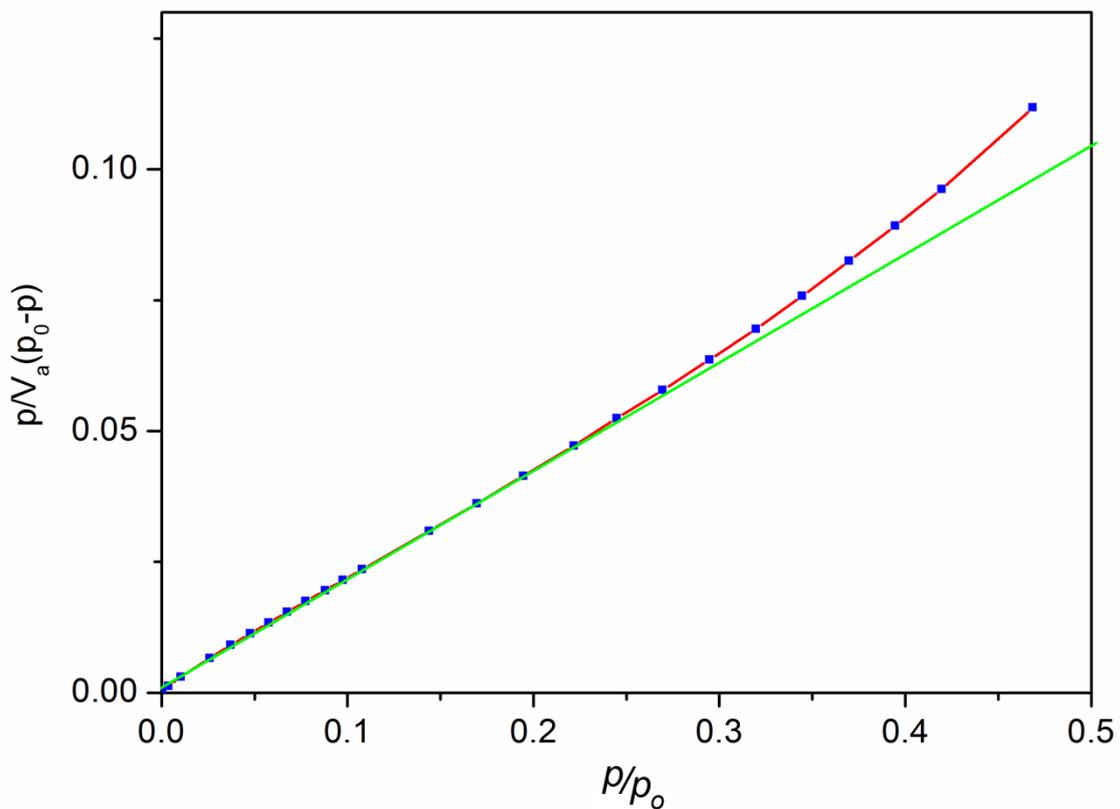


Fig. 4S BET plot fitting for surface area measurements.

5) Chemical structure of the two food dyes (Blue and Yellow)

A mixture of two food dyes used in this study are FD&C blue No 1 or brilliant blue (IUPAC name: ethyl - [4 - [[4 - [ethyl -[(3 - sulfophenyl) methyl] amino] phenyl] - (2 - sulfophenyl) methylidene] - 1 - cyclohexa - 2, 5 - dienyldiene] - [(3 - sulfophenyl) methyl] azanium) and FD&C Yellow No 5 also known as tartrazine (IUPAC name: Trisodium (4*E*)-5-oxo-1-(4-sulfonatophenyl)-4-[(4-sulfonatophenyl)hydrazono]-3-pyrazolecarboxylate). The chemical structure of both the dyes are provided in Fig. 5S. Both dyes are hydrophilic; however, their separation in the DE packed microfluidic channel is based on their polarity and size, as brilliant blue is less polar and slightly with larger size than tartrazine, which is explanation why tartrazine elutes out faster.

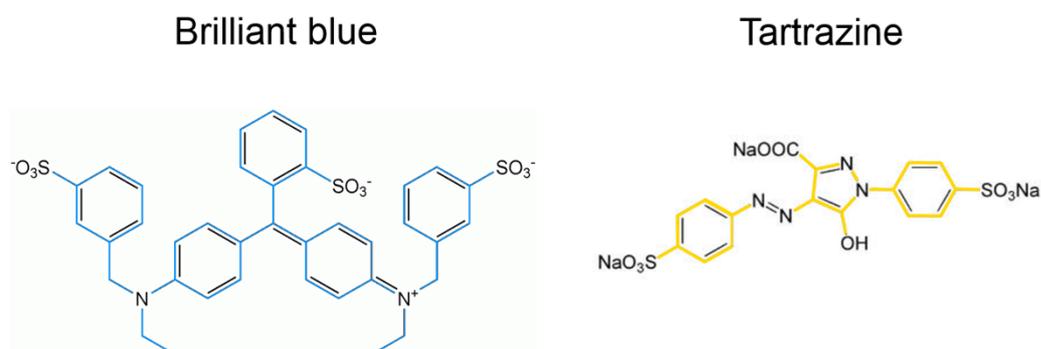


Fig. 5S Chemical structures of two dyes used as model molecules in the chromatographic separation

Reference:

1. Y. Yu, J. Addai-Mensah and D. Losic, *Langmuir*, 2010, **26**, 14068-14072.

6) Captured videos showing the process of frit-free packing of DE using MNPs

Video 1 Packing DE and MNPs with magnet

Video 2 Packing DE and MNPs without of magnet (control experiment)