

# Supplementary Information

## Magnetic Fe<sub>3</sub>O<sub>4</sub> nanoparticle heaters in smart porous membrane valves

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### Experimental section

#### Synthesis of the cationic macroinitiator (BEE-TH)

The preparation of the cationic photoreactive macroinitiator consists of three steps. First, a benzoin ethyl ether with bromide group (BEE-COBr) was synthesized. In parallel, a copolymer of dimethylaminoethylmethacrylate (DMAEMA) and 2-hydroxyethylmethacrylate (HEMA) was synthesized via free radical polymerization and subsequently quaternized. In the third step both substances were coupled by esterification of the HEMA hydroxyl groups with BEE-COBr.

##### 1. Synthesis of 4-ethoxy-5-oxo-4,5-diphenylpentanoyl bromide (BEE-COBr)

20 g of benzoin ethyl ether were dissolved in 32 ml DMSO. 8 ml ethyl acrylate and 2 ml 4 mol/L KOH were added. The mixture was stirred for 4 h at room temperature. After evaporating the DMSO at 80 °C under vacuum the residue was dried under vacuum and dissolved in 1 mol/L NaOH solution containing 6 % methanol and hydrolysed for 24 h at room temperature. After freeze-drying the solid was dissolved in dichloromethane and filtrate to remove the hydroxide. After drying under vacuum BEE-COOH was obtained. 8 g of BEE-COOH and 20 mg red phosphorous were dissolved in 160 ml dry THF. 4.1 g bromine in 40 ml THF were added dropwise and the mixture was stirred for 5 h at 80 °C. After filtration the THF was evaporated under vacuum and the residue was dried under vacuum at 40 °C.

##### 2. Synthesis of poly(TMAEMA-co-HEMA) (TH)

5.9 g DMAEMA, 1.4 g HEMA and 83.8 mg AIBN were dissolved in 10 ml dry THF and degassed by argon. The polymerization took 2 h at 60 °C under argon. Then the solution was diluted with 10 ml THF and precipitated into water (60 °C, pH 11). After drying the precipitation under vacuum it was redissolved in 15 ml THF and precipitated into 500 ml hexane. The filtrate residue was dried under vacuum at room temperature. 2 g of the solid were dissolved in 30 ml THF and a solution of 1.25 ml iodomethane in 10 ml THF were added and stirred for 1 h. After the solution

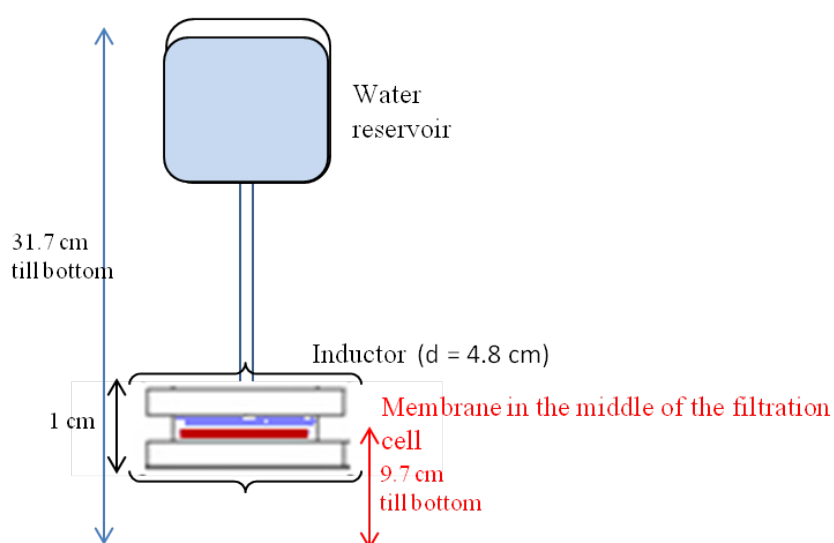
was precipitated in 500 ml hexane, washed with hexane and dried under vacuum at room temperature.

### 3. Synthesis of BEE-TH

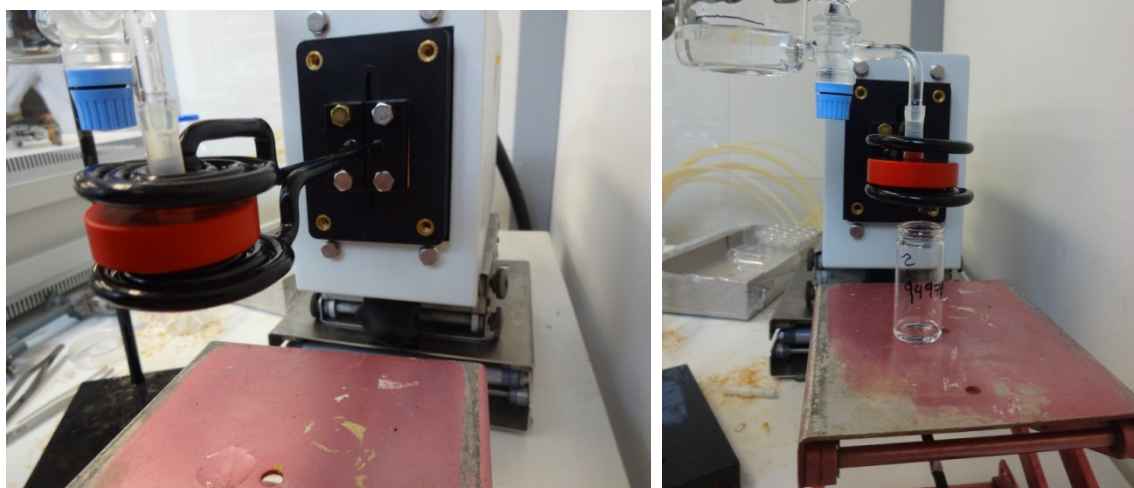
0.3 g of BEE-COOBr were dissolved in 10 ml dry N-methyl-pyrrolidone (NMP). 0.75 g poly(TMAEMA-co-HEMA) dissolved in 20 ml dry NMP were added dropwise and the mixture was stirred 5 h at room temperature under argon. To precipitate the polymer the solution was added to THF and the polymer was dried under vacuum at room temperature.

### Filtration setup

Pressure of 2100 Pa

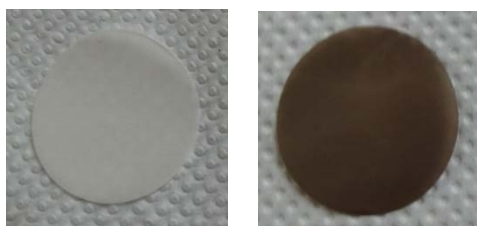


Schematic overview of filtration set-up



Photographs of filtration set-up

### Additional results



Aminated PET

PET\_NP

Optical images of membranes before and after immobilization of  $\text{Fe}_3\text{O}_4$  nanoparticles.