Fabrication of novel hollow fiber membrane decorated with functionalized Fe_2O_3 nanoparticles: Towards sustainable water treatment and biofouling control

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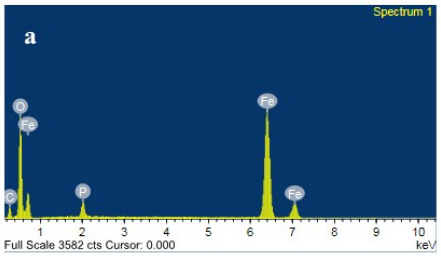
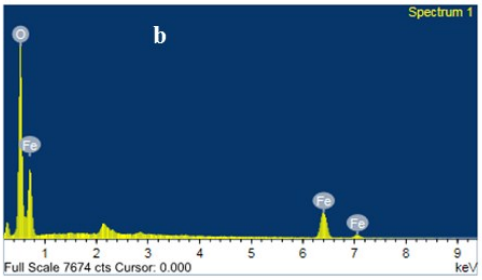
S-1 The elemental composition of a) modified and b) unmodified Fe_2O_3 nanoparticles



Elem...	Weight%	Atomic%	Compd%	Formula
O K	23.42	49.48	32.21	O2C
P K	1.79	1.96	0.00	
Fe K	39.36	23.82	0.00	
C	8.79	24.74		
Totals	73.36			



Elem...	Weight%	Atomic%	Compd%	Formula
O K	3.55	48.76	4.89	O2C
Fe L	6.83	26.86	0.00	
C	1.33	24.38		
Totals	11.72			

S-2 porosity of hollow fiber membrane

Porosity of nanocomposite hollow fiber membranes was determined by dry-wet weight system. In brief, the dry membrane was immersed in water and weighed after wiping the surface water. The obtained wet membrane was kept in a hot air vacuum oven at 75° C for 24 hrs prior to measure the dry weight. The porosity of membrane was calculated using equation

$$P(\%) = \frac{W_w - W_d}{\rho_w \times A \times \delta} \times 100$$

Where, $'P'$ is the porosity of membrane, $'\rho_w'$ is the density of water (0.998 g/cm^3), $'A'$ is the area of membrane (cm^2) and $'\delta'$ is the thickness of membrane (cm).

S-3 *Contact angle analysis*

The surface hydrophilic nature of prepared hollow fiber membrane was evaluated by the water contact angle measurement. It was determined using FTA-200 Dynamic contact angle analyzer according to the sessile droplet method. From the obtained contact angle values, the work of adhesion or surface energy (ωA) of the membranes could be determined as

$$\omega_A = \gamma_w(1 + cos\theta)$$

Where, ω_A is the surface energy (mN/m), γ_w is the surface tension of water (7.2×10^{-2} N/m) and θ is the contact angle.

S-4 Anti-biofouling study

Antimicrobial property of the MHNTs modified membrane was investigated by inhibition of microbial growth according to the literature.[15] In brief, the standard cultures of three bacteria *Mycobacterium smegmatis* (MTCC 994), *Staphylococcus aureus* (MTCC3160) and *Escherichia coli* (MTCC1687) and fungi *Candida albicans* (MTCC 7253) was obtained from IMTECH, Chandigarh, India. Microbial cultures were grown in nutrient agar media and sub cultured into nutrient broth. Hundred microlitre of microbial culture (0.5 Mac Farland) was spread on the agar plate using a cotton bud. Membranes were cut into pieces and placed on microbial mat with active surface facing the culture. Incubated the plates for 12 hours and observed for the zone of inhibition. Standard Fluconazole and Ciprofloxacin prepared at 10 mg/mL concentration was used as reference standards for fungi and bacteria respectively.

Another set of experiment was carried out to check the anti-biofouling capacity of the membranes by incubation method. In brief, membranes were cut into size strips and incubated in 100 times diluted 0.5 Mac Farland microbial culture in a test tube for 12 hours. Sterile whatman filter paper strip of similar size was used as control. After 12 hours of incubation, all the strips were taken out, drained and placed on nutrient agar plates. Agar plates are observed for the microbial colonies around the membranes.