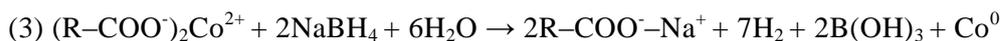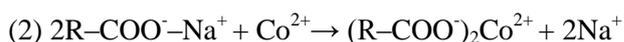**Electronic Supplementary Information**

S0. Intermatrix Synthesis (IMS) reactions of Ag@Co nanoparticles formation by using carboxilated fibrous material, FIBAN K-4.

The following reactions describe the ion exchange and the reduction steps when a carboxilated material is used to the IMS methodology.

(1) $R–COO^-–H^+ + NaBH_4 + 3H_2O \leftrightarrow 2R–COO^-Na^+ + B(OH)_3 + 4H_2$

(2) $2R–COO^-–Na^+ + Co^{2+} \rightarrow (R–COO^-)_2Co^{2+} + 2Na^+$

(3) $(R–COO^-)_2Co^{2+} + 2NaBH_4 + 6H_2O \rightarrow 2R–COO^-–Na^+ + 7H_2 + 2B(OH)_3 + Co^0$

S1. Nanocomposite characterization
S1.1. ICP-AES
Samples of PS-MNPs (5.0 mg) were digested with 1.0 ml of concentrated nitric acid between 5 and 10 hours to oxidize metals and release the cations to the solution. The sample was diluted and filtered using 0.22 μm Millipore filters before the analysis. The metal content was determined by Induced Coupled Plasma Atomic Emission Spectrometry (ICP–AES) using an Iris Intrepid II XSP spectrometer (Thermo Electron Co.) at Servei de Microscopia from Universitat Autònoma de Barcelona. The instrumental average uncertainty of metal ions determination was in all cases lower than 2%.
Before the sample measurement, the ICP-AES signal corresponding to each metal was calibrated with certified standard solutions (JT Baker). The wavelengths that showed better sensitivity without interference were chosen.

S1.2. SEM and TEM characterization
Scanning Electron Microscope (SEM) coupled with Energy-Dispersive Spectrometer (EDS) (JEOL JSM 3600, Jeol Ltd.) was used to obtain the metal concentration profiles along the cross-section (cut it under N_2) of PS-MNP-containing materials. Transmission Electron Microscope (TEM, JEOL 2011, Jeol Ltd.) was used to characterize the size and the morphology of MNPs and their particle size distributions. Prior to the TEM examination, samples were embedded in an epoxy resin (Supporting Information S1.2) and cross-sectioned with a Leica EM UC6 Ultramicrotome using a 35° diamond knife (Diatome).
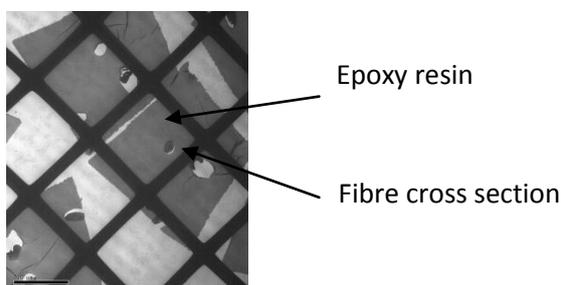

Fig. S1. TEM image which shows the embedded fibre in an epoxy resin and cross-sectioned with a Leica EM UC6 Ultramicrotome using a 35° diamond knife (Diatome)

S1.3. SQUID measurement

Superconducting Quantum Interference Device (SQUID), from Institut de Ciències dels

Materials from Barcelona (CSIC), was used to determinate the magnetic properties of the developed polymer-metal nanocomposites. In few words, SQUID is a very sensitive magnetometer used to measure extremely weak magnetic fields, based on superconducting loops containing Josephson junctions. In our case, an SQUID MPMS-XL7 was used at 300K within a working range of the magnetic field intensity from 0 to 7 T. Fibres samples of 5 mg were accuratly introdcued in a suitable test tubs and the magnteization was analysized at room temperature.

S2. Metal distribution of Ag@Co-FIBAN K-4 propylene fibre cross-sections

SEM, TEM and EDS characterization of Ag@Co-carboxylated matrx, FIBAN K-4. Fig. S2 (a and c) shows the metal distribtion on the fibre surface as it was observed in Fig.1 of this work for sulfonated fibre, FIBAN K-1. However, Fig. S2 (b) shows also the presence of NPs on the porous inside the matrix.
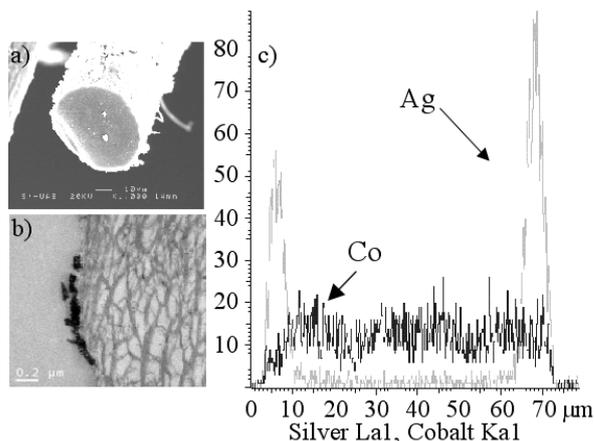

Fig. S2. a) SEM image, b) TEM image of Ag@Co FIBAN K-4 fibre cross-section and, c) corresponding LineScan EDS spectra.

S3. Nanoparticles distribution size in membrane material

The Ag@Co sulfonated membranes synthesized by the same procedure as the ones reported in this work were analyzed by TEM. Fig.S2. shows the Ag@Co NPs distribution stabilized in Sulfonated polyetherether ketone membrane. The nanoparticle average size was found to be 5 nm, which was largely different from the 16 nm obtained for the fibres samples described in this work. This fact demonstrates that the NPs size distribution may be dependent on the polymeric matrix.
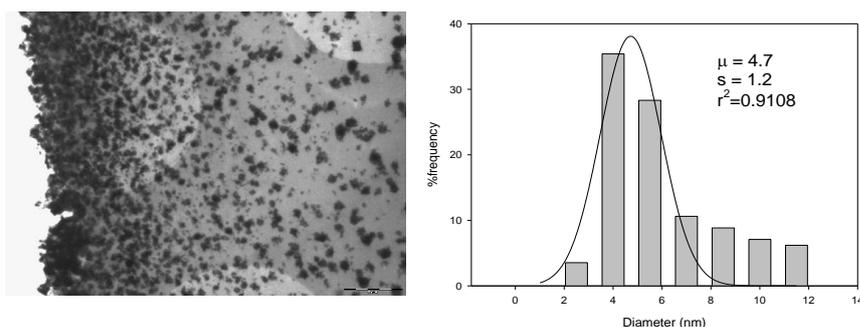
Fig.S3. a) TEM image of fibre cross section after loading with Ag@Co nanoparticles and b) Ag and Co LineScan EDS spectra

S4. Experimental Set up to bactericidal analysis

The recirculation experimental conditions for the bactericide activity test are detailed in the following figure (FIg.S3).
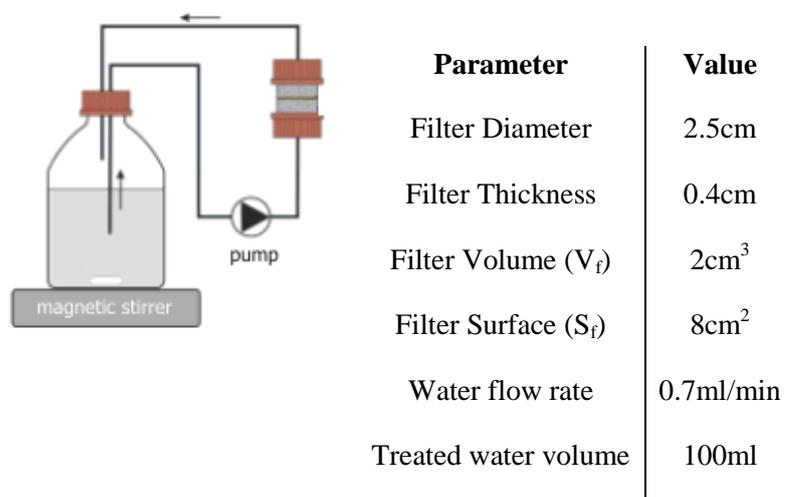

Parameter	Value
Filter Diameter	2.5cm
Filter Thickness	0.4cm
Filter Volume (V_f)	$2cm^3$
Filter Surface (S_f)	$8cm^2$
Water flow rate	0.7ml/min
Treated water volume	100ml

Fig.S4. Scheme of the experimental setup and experimental conditions for flow experiments.