

Support information

For

Enhancing antimicrobial properties of poly(vinylidene fluoride)/hexafluoropropylene copolymer membrane by electron beam induced grafting of N-vinyl-2-pyrrolidone and iodine immobilization

Ahmed Ibrahim Shawky^a, Megat Johari Megat Mohd Noor^a, Mohamed Mahmoud Nasef^{a,b*}, Mohamed Khayet^{c,d*}, Madana Nallappan,^b Zaini Ujang^e

^a*Department of Environmental Engineering and Green Technology, Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia*

^b*Center for Hydrogen Energy, Institute of Future Energy, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia*

^c*Department of Applied Physics I, Faculty of Physics, University Complutense of Madrid, Spain*

^d*Madrid Institute for Advanced Studies of Water (IMDEA Water Institute), Avda. Punto Com, n° 2, 28805, Alcalá de Henares, Madrid, Spain*

^e*Centre for Environmental Sustainability & Water Security, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia*

Evaluation of physical changes in the membranes

The weight change was used to differentiate between the pristine PVDF-*co*-HFP, grafted PVDF-*co*-HFP/PVP, and PVDF-*co*-HFP/PVP-I₂ membranes. The colour change and the variation in membrane dimensions measurement were monitored by necked eye, digital calibre (Mitutoyo, Japan), and digital micrometer (Mitutoyo, Japan), respectively.

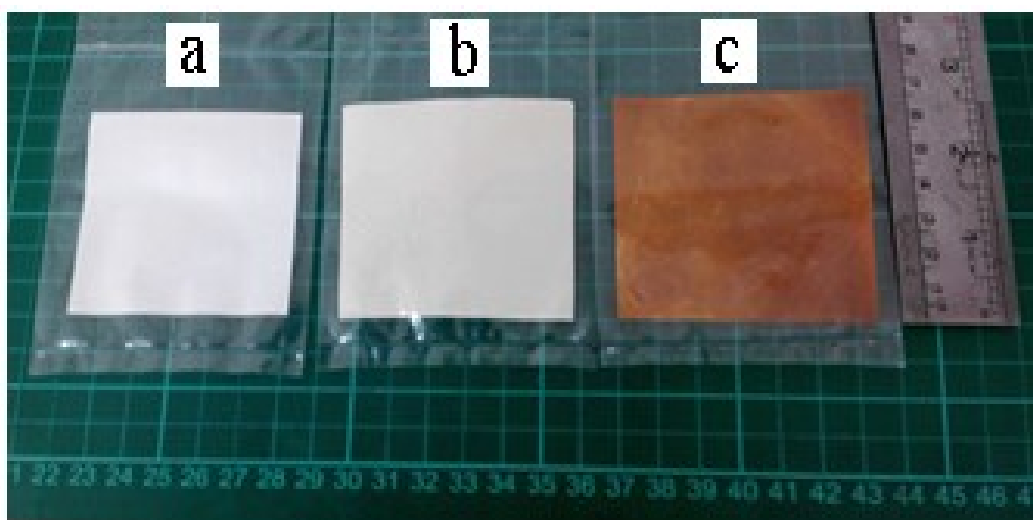


Figure S1. Variation in the colours and dimensions of : a) pristine PVDF-*co*-HFP, b) grafted PVDF-*co*-HFP/PVP and c) PVDF-*co*-HFP/PVP-I₂ membranes.

The changes in colors and dimensions of the membranes samples were monitored after grafting and treatment with iodine and the changes are shown in the images presented in Figure S1. Grafting of NVP onto PVDF-*co*-HFP membrane was not accompanied by any color change (both original and grafted membranes have white color). Unlikely, iodine loaded membrane was turned to yellow brownish colour.

Grafting of NVP onto PVDF-*co*-HFP membrane and subsequent iodine loading was also accompanied by an increase in length, width and thickness (dimensions) of the grafted and functionalized membranes.

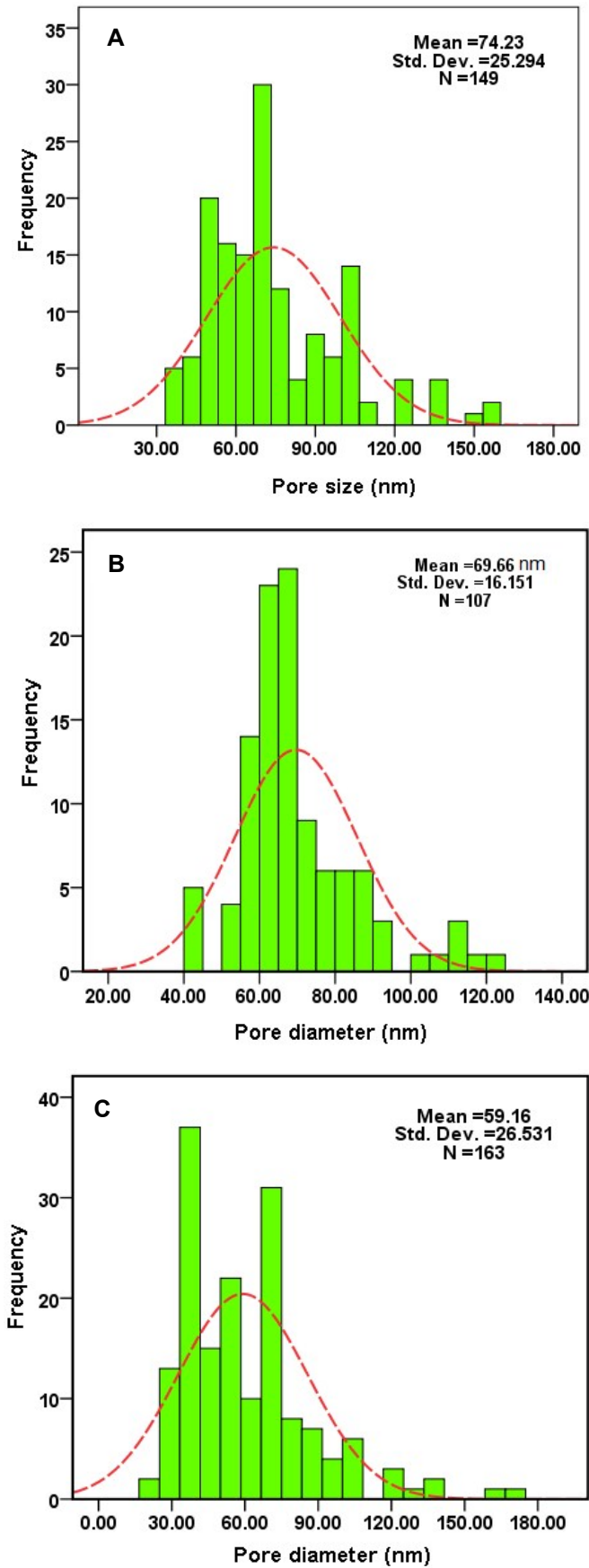


Figure S2. Pore size distribution of: a) pristine PVDF-*co*-HFP, b) grafted PVDF-*co*-HFP/PVP and c) PVDF-*co*-HFP/PVP-I₂ membranes.

For instance, the dimensions of the membrane increased from 6 cm×6 cm×0.00043 cm to 6.37 cm×6.4 cm× 0.00045 cm after grafting of NVP and then to 6.49 cm×6.52 cm×0.00046 cm after iodine loading. These observations provide evidence for incorporation of PVP-I₂ complex in the membrane.

The pore size distributions of the pristine PVDF-*co*-HFP, grafted PVDF-*co*-HFP/PVP, and PVDF-*co*-HFP/PVP-I₂ membranes are given in Figure S2. The mean pore size of the PVDF-*co*-HFP film was 74.23 nm (SD + 26.291) which was reduced to 69.66 nm (SD = 16.15) by grafting of PVP and further lowered by I₂ immobilization to 59.16 nm (SD = 26.5).

The images associated with EDX analysis is presented in Figure S3. The pristine PVDF-*co*-HFP membrane shows nanopores evenly distributed on a smooth surface. The grafted PVDF-*co*-HFP membrane showed obvious changes in the surface in a form appearance of uneven layers of PVP grafts while retaining some nanopores in a distribution pattern similar to the pristine membrane. The incorporation of iodine in the grafted membrane seems to be evenly distributed on the surface and some aggregated iodine particles seem accumulating on the entrances of some of the nanopores.

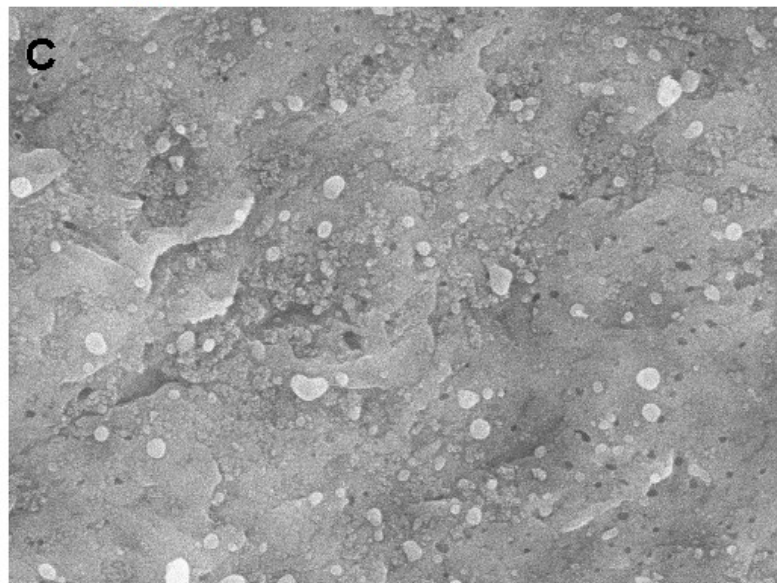
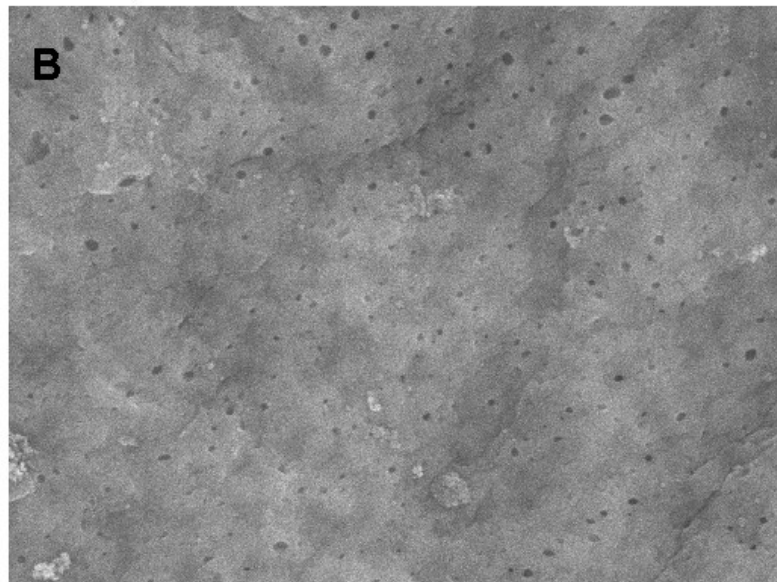
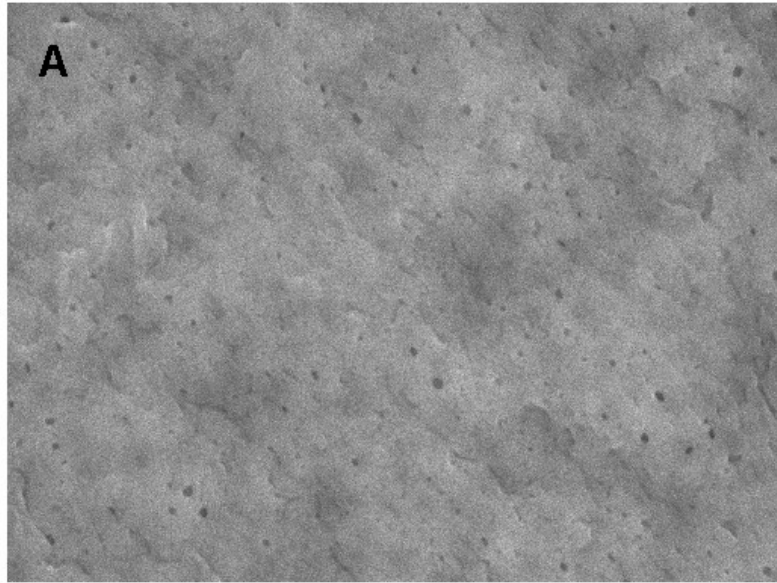


Figure S3. Images associated with EDX analysis of: a) pristine PVDF-*co*-HFP, b) grafted PVDF-*co*-HFP/PVP and c) PVDF-*co*-HFP/PVP-I₂ membranes.