Supplementary information

Improving PFSA membranes using sulfonated nanodiamonds

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Thermogravimetric analysis (TGA)

We have performed TGA tests of some Aquivion®-type membranes without diamonds: SSC-1 membrane with EW 790 g-eq/mol and SSC-2 membrane with EW 870 g-eq/mol. TGA was carried out in the temperature range 50-1000 °C for membranes SSC-1 and SSC-2 with different chemical composition (equivalent weight, EW). Thermal stability and the process of desulfonation were studied. Figure S1 shows the results of thermal-oxidative degradation of membrane copolymers in air.

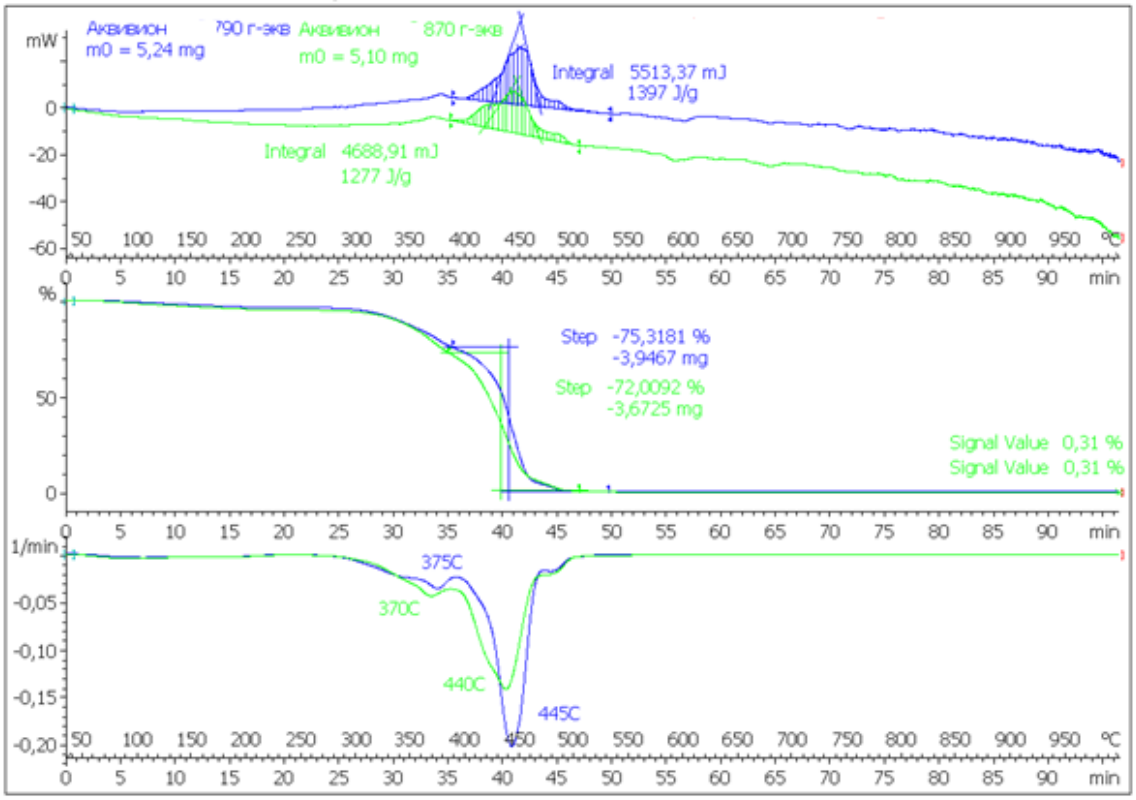

Figure S1. TGA tests of SSC-1 (EW 790 g-eq/mol, blue) and SSC-2 (EW 870 g-eq/mol, green) membranes.

3 main stages of membranes' destruction were identified. The total weight loss of all membranes up to 300 °C is associated with water evaporation. The weight loss at 300–400 °C is associated with desulfurization and decomposition of the side chains, and the weight loss above 400 °C is due to thermal destruction of the backbone of the copolymer.

Scanning electron microscopy (SEM)

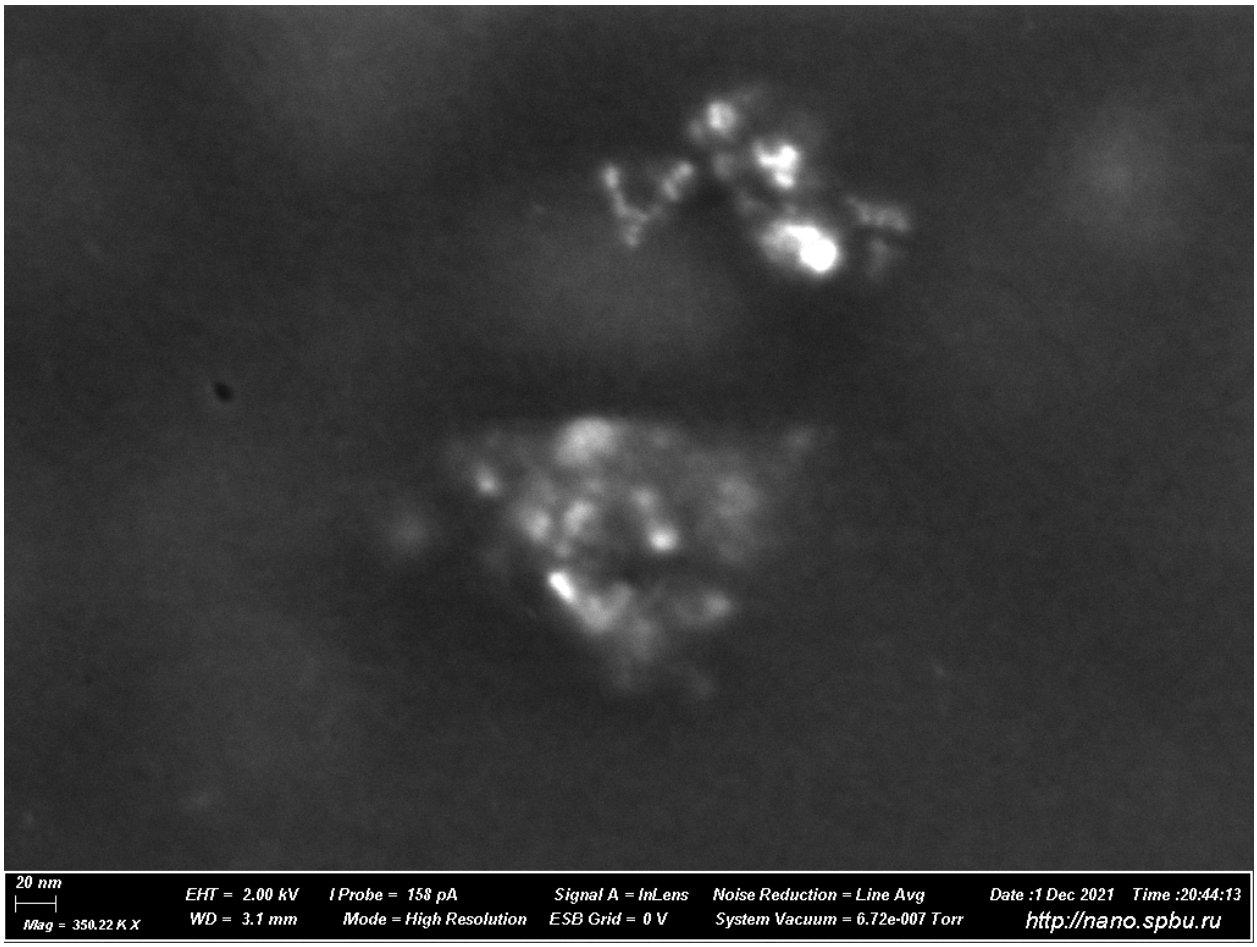

Figure S2. SEM image of Aquivion®-type compositional membrane with 0.5 wt.% of DND-S.

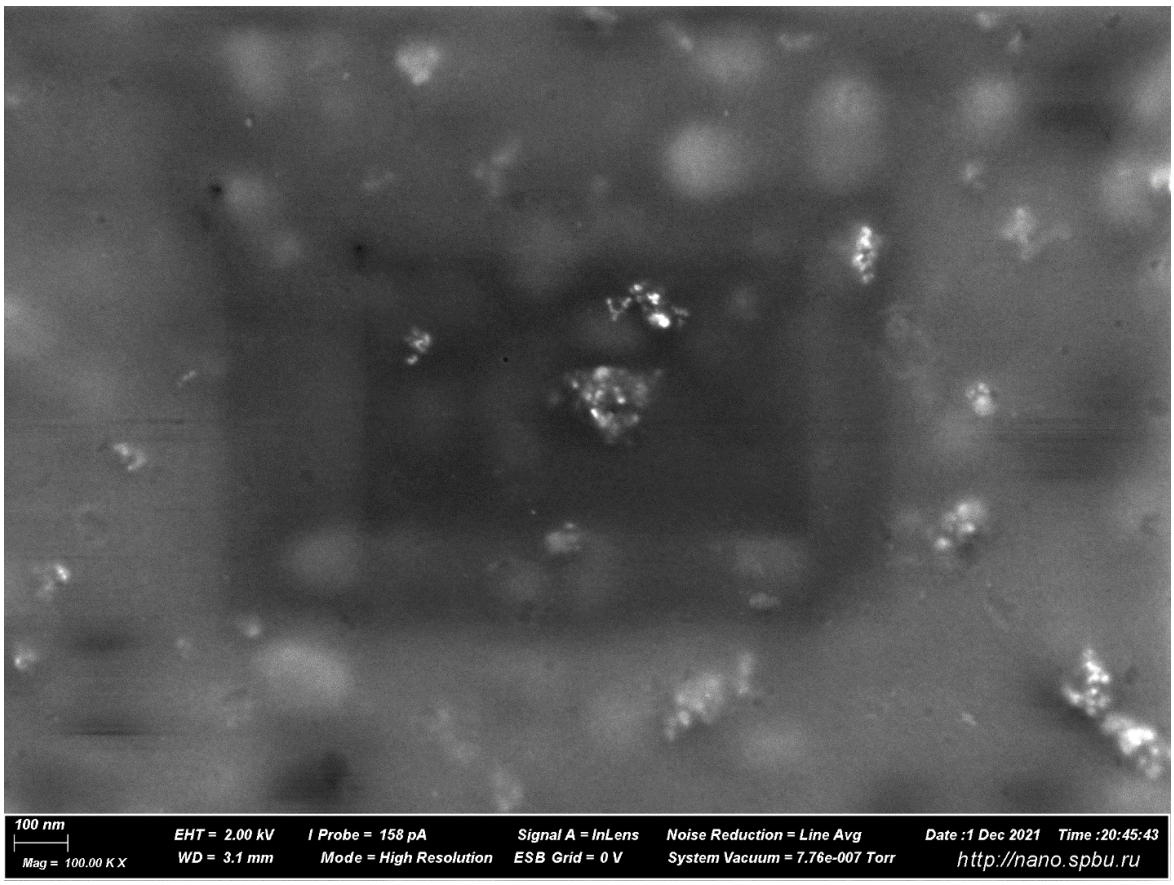

Figure S3. SEM image of Aquivion®-type compositional membrane with 0.5 wt.% of DND-S.

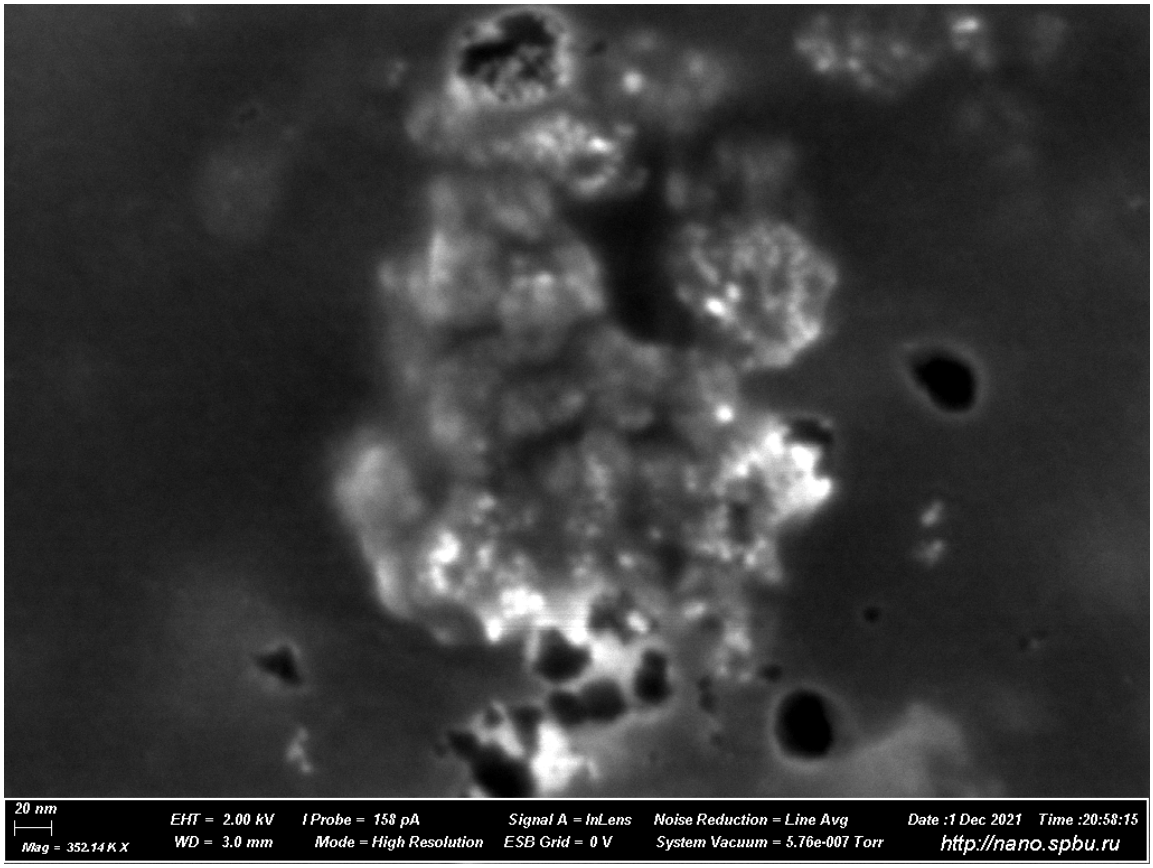

Figure S4. SEM image of Aquivion®-type compositional membrane with 1 wt.% of DND-S.

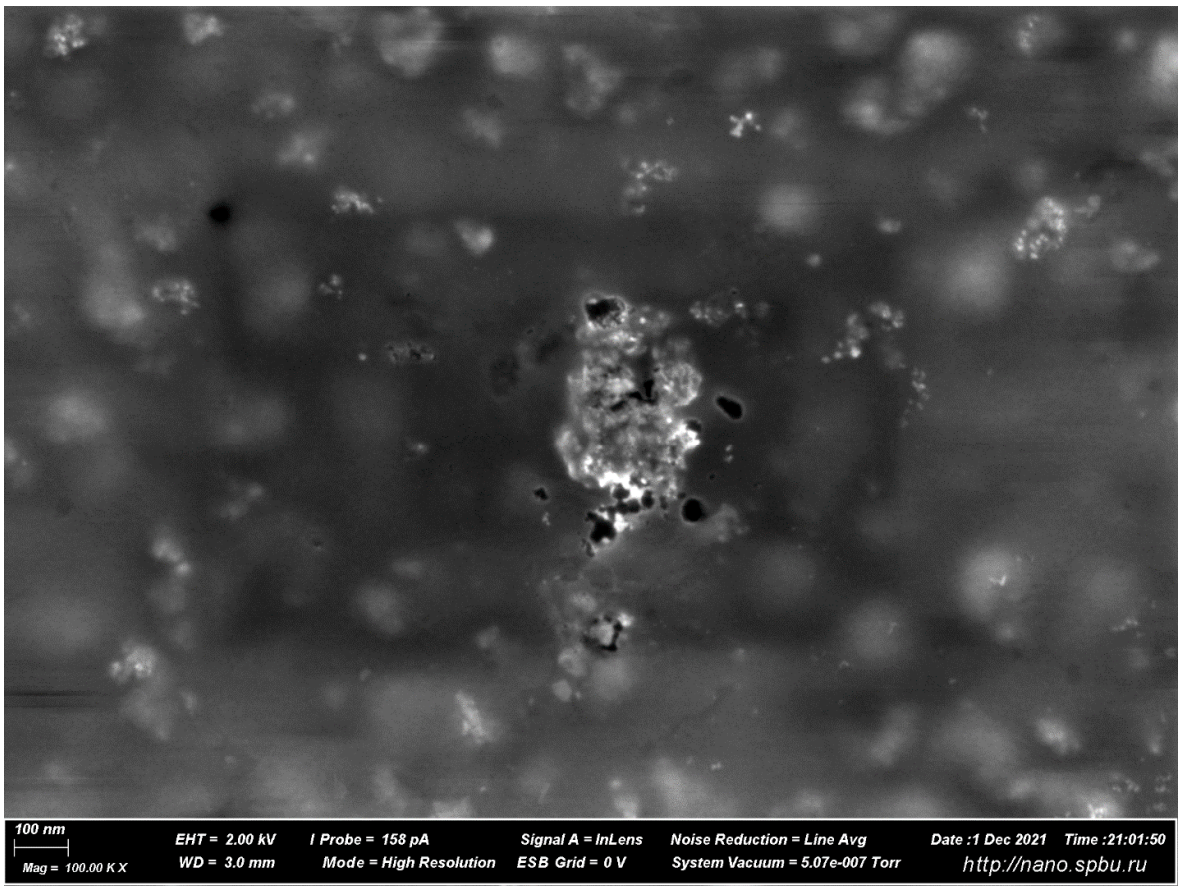

Figure S5. SEM image of Aquivion®-type compositional membrane with 1 wt.% of DND-S.

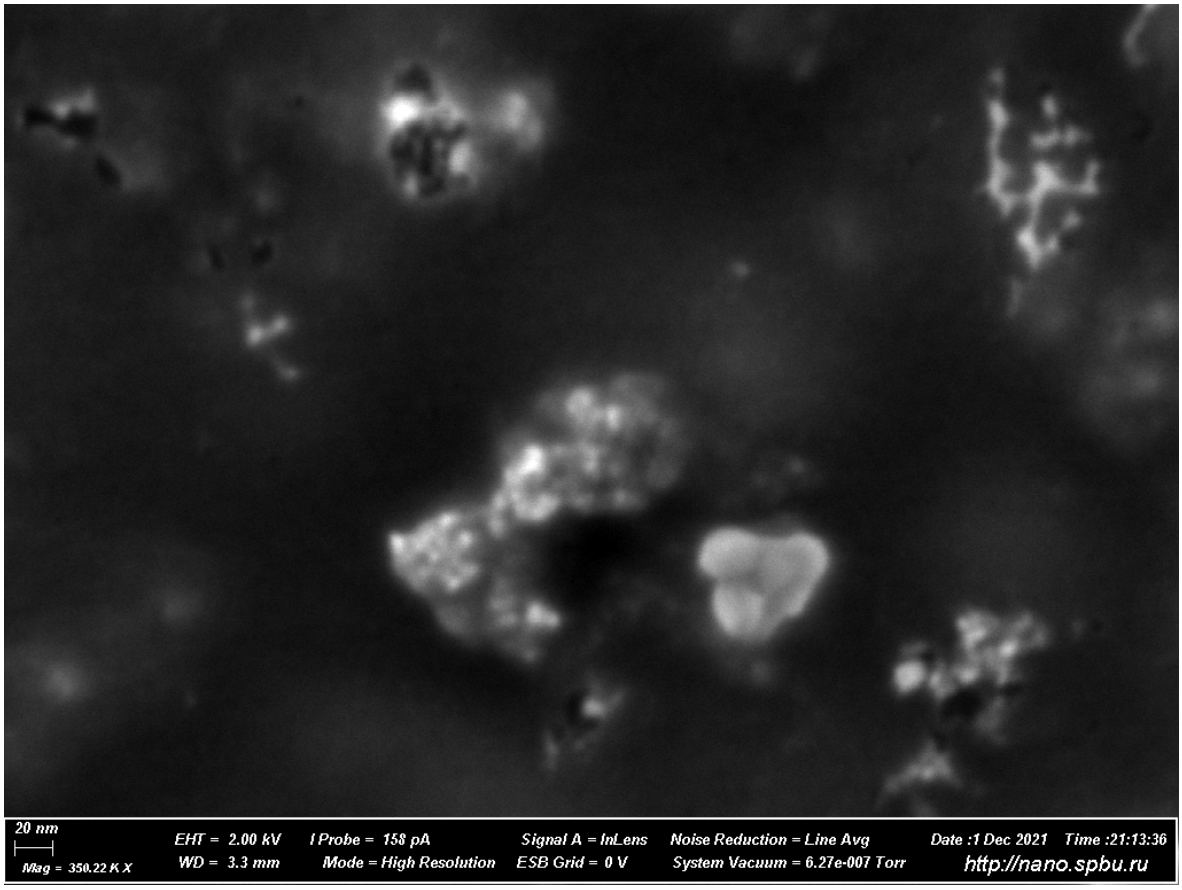

Figure S6. SEM image of Aquivion®-type compositional membrane with 2 wt.% of DND-S.

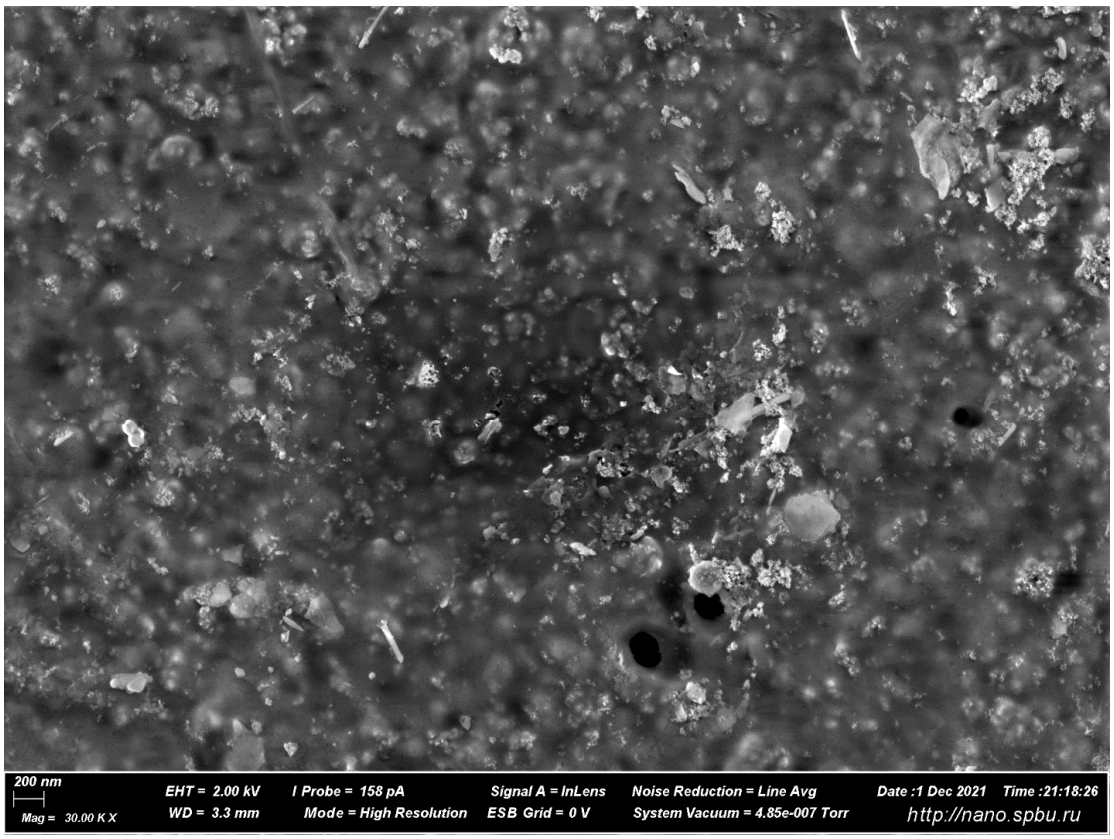

Figure S7. SEM image of Aquivion®-type compositional membrane with 2 wt.% of DND-S.

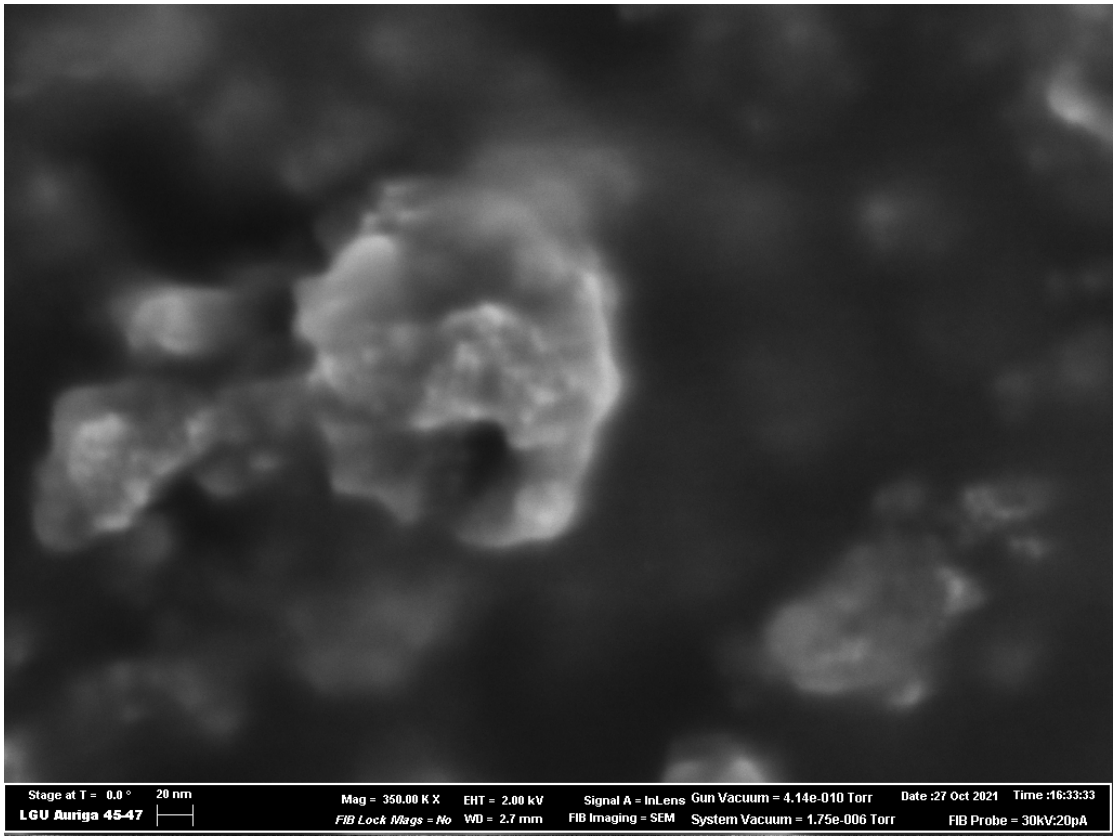

Figure S8. SEM image of Aquivion®-type compositional membrane with 5 wt.% of DND-S.

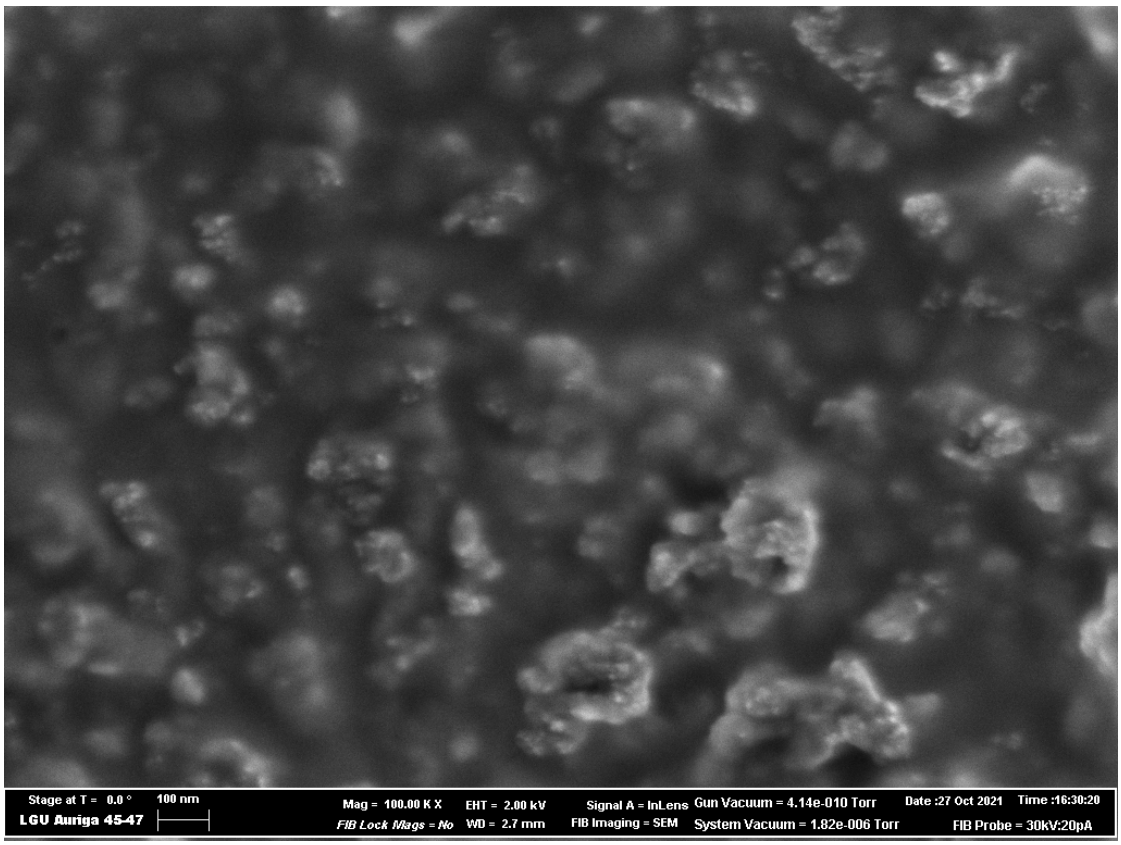

Figure S9. SEM image of Aquivion®-type compositional membrane with 5 wt.% of DND-S.