Electronic Supplementary Material (ESI) for RSC Advances

Supplementary Data

Nanochannel Conduction in Piezoelectric Polymeric Membrane using Swift Heavy Ions and Nanoclay

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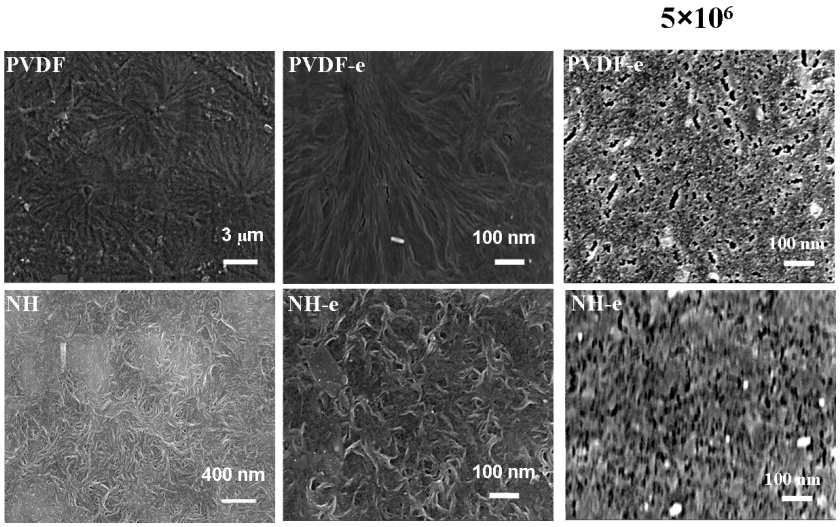

Figure S1: Top layer SEM images of pure *PVDF, PVDF* after etching (*PVDF-e*), irradiated *PVDF* after etching at fluence 5×10^6 ions/cm^2. Bottom layer pure *NH, NH* after etching (*NH-e*) and irradiated *NH* after ettching with fluence 5×10^6 ions/cm^2. It is obvious that unirradiated specimens do not exhibit any channels or holes alternatively confirm that irradiation is a precondition to create channel in polymeric matrix/membrane. Spherulitic morphology is evident for pure PVDF while mesh-like morphology is prominent in nanohybrid and their respective morphologies do not change after etching.

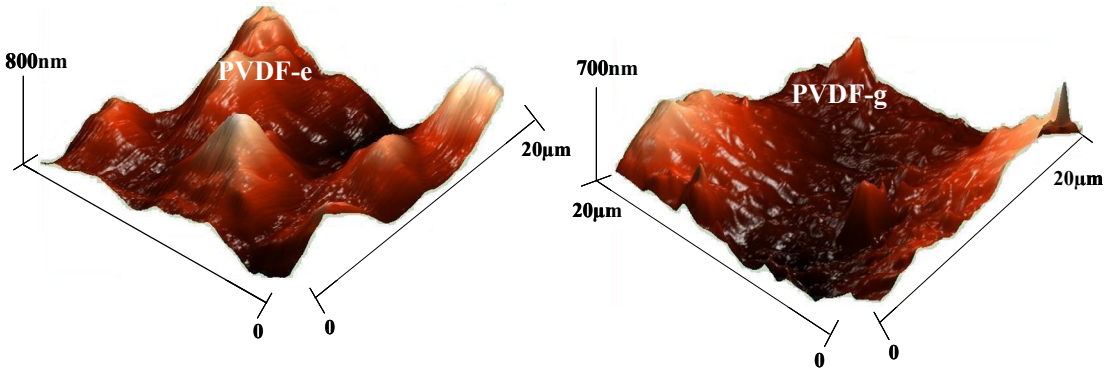

Figure S2: AFM topographs of *PVDF-e*, *PVDF-g*, with fluence 1×10^{10} ions/cm^2. It is important to mention that PPy grafting on to *PVDF* corresponding *NH* as shown in Fig. 3 of the manuscript.

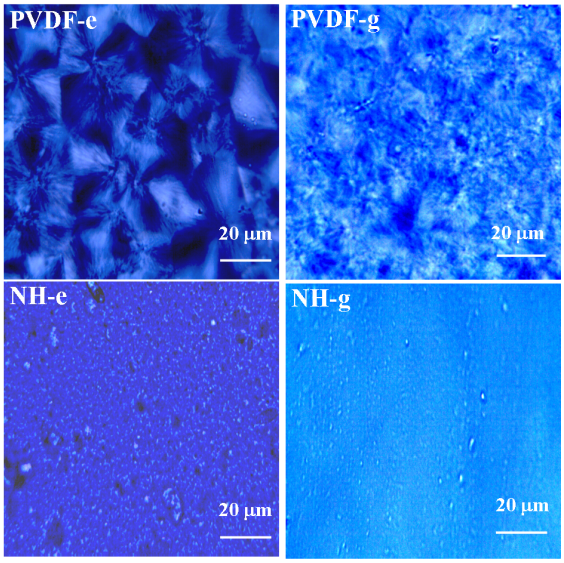

Figure S3: Polarized optical micrographs of *PVDF-e*, *PVDF-g*, *NH-e* and *NH-g* with fluence 1×10^{10} ions/cm^2. The signs –e and –g indicate the respective etched and grafted specimens. Hence, creating hole on the irradiated samples and grafting of polypyrrole has been confirmed.

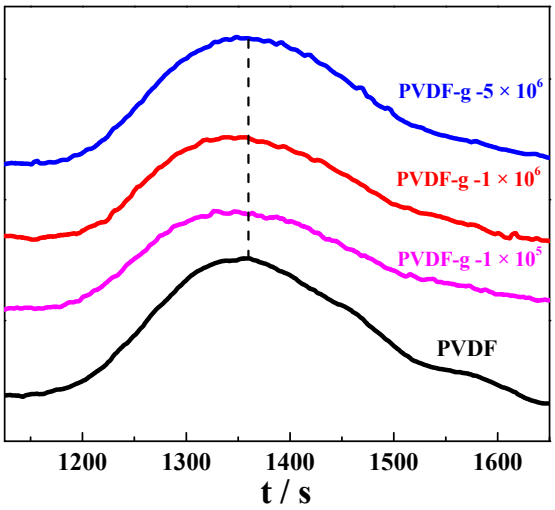

Figure S4: GPC traces of neat *PVDF* and grafted *PVDF* with three different fluences.

Sample code	M_w (g.mol^{-1})	M_w/M_n (*PDI*)
PVDF	2.7×10^{-5}	2.09
PVDF-g-1×10^5	2.5×10^{-5}	3.03
PVDF-g-1×10^6	2.6×10^{-5}	2.99
PVDF-g-5×10^6	2.7×10^{-5}	2.19
NH	2.5×10^{-5}	2.31
NH-g-1×10^5	2.7×10^{-5}	2.13
NH-g-1×10^6	2.8×10^{-5}	2.44
NH-g-5×10^6	2.9×10^{-5}	2.16

Table S1. Molecular weight and *PDI* value of grafted with *PVDF* and *NH* samples.

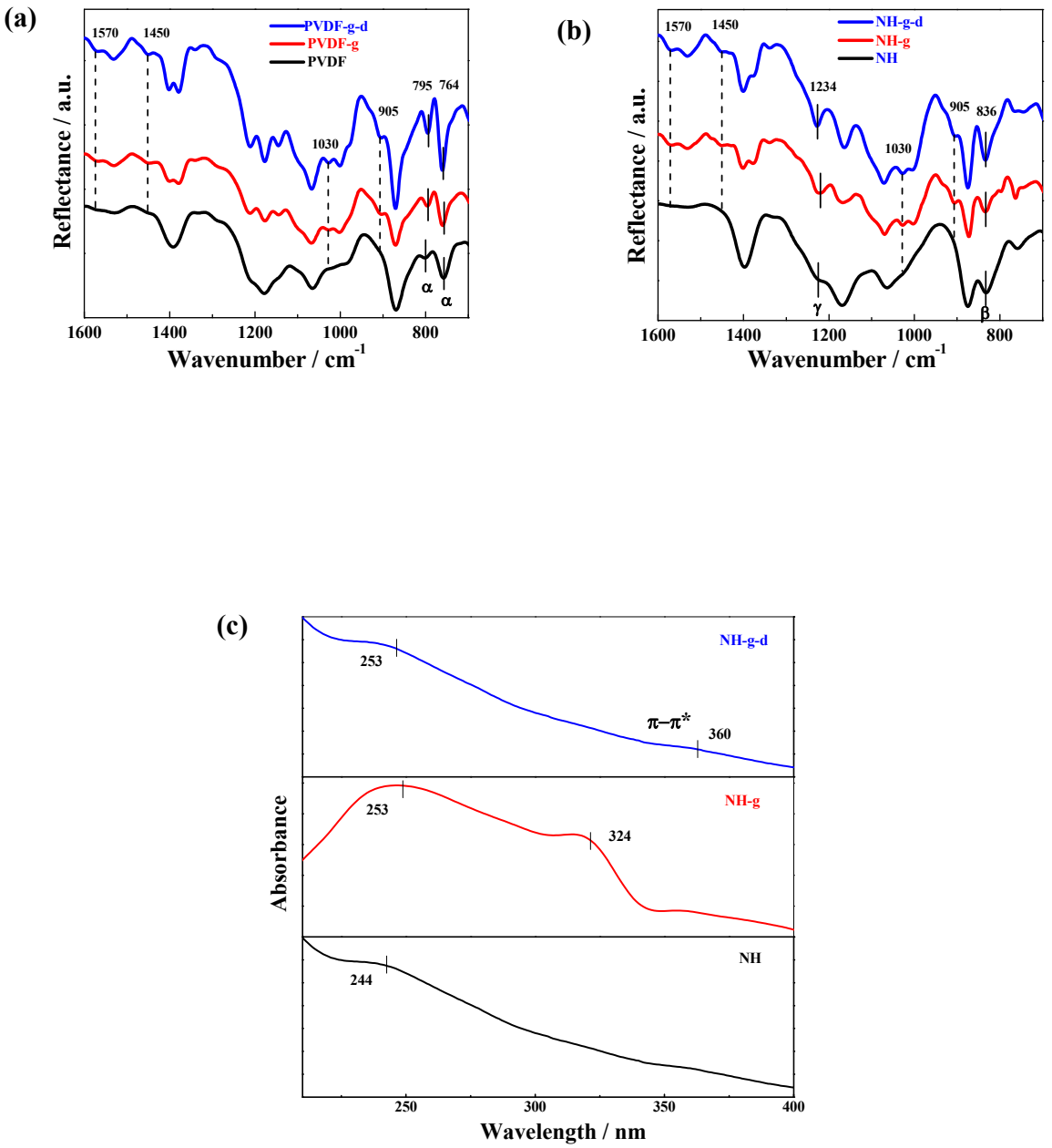

Figure S5: FTIR spectra of (a) neat *PVDF*, *PVDF-g* and *PVDF-g-d* specimen. (b) Pristine *NH*, *NH-g* and *NH-g-s* samples. This result clearly indicates that the peak intensity increases after doped. (c) *UV-Vis.* absorption spectra of pure *NH* and grafted *NH,* grafted-doped *NH*. Pure *NH* does not have any absorption peak while characteristics absorption peaks of polypyrrole and sulphonate groups are clearly visible in *NH-g* and *NH-g-d* specimen suggesting grafting and doping on the *PVDF* chain.

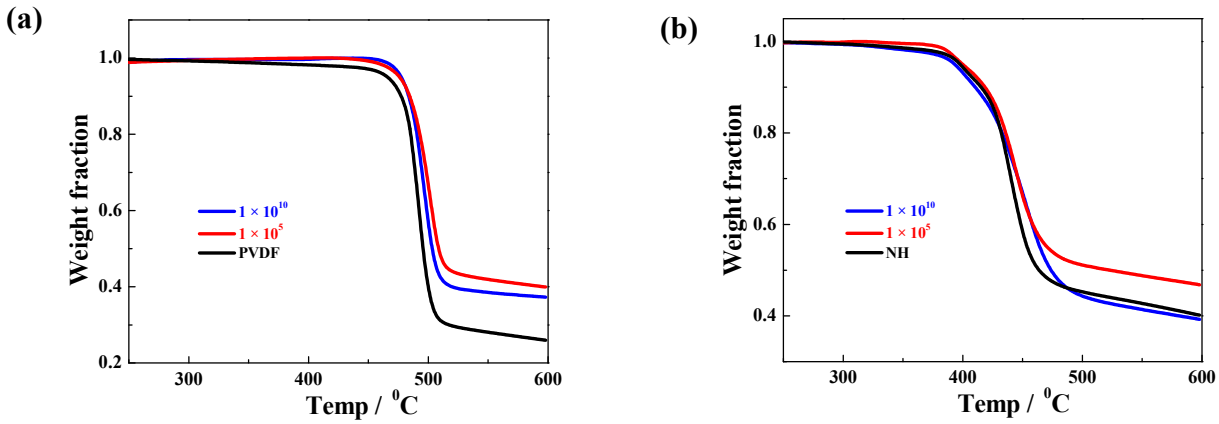

Figure S6: TGA thermograms of neat *PVDF*, *PVDF-g* at fluence 1×10^5 and *PVDF-g* with fluence 1×10^{10} ions/cm^2. (b) pristine NH and NH-g with the fluences 1×10^5 and 1×10^{10} ions/cm^2, respectively.

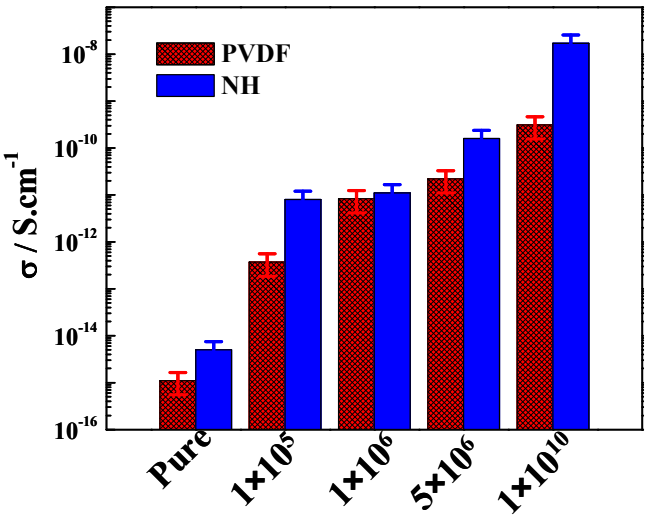

Figure S7: Bulk electrical conductivity measurement of pristine *PVDF*, *NH* and grafted specimen of *PVDF*, *NH* with four different fluences.

Sample Code	E_a (KJ/mole)
PVDF	10.65
NH	6.88
PVDF-g-d-1×10^{10}	12.80
NH-g-d-1×10^{10}	26.93
PVDF-g-s-1×10^{10}	12.58
NH-g-s -1×10^{10}	25.86

Table S2. Activation energy of grafted, dopant and sulphonated specimen of *PVDF* and *NH* with fluence 1×10^{10} ions/cm^2.