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NOVEL PBI/GO COMPOSITES FOR POTENTIAL USE IN PROTON EXCHANGE MEMBRANE ELECTROCHEMICAL DEVICES

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Abstract

The urgency of developing innovative electrolytes for proton exchange membrane electrochemical devices, able to outperform Nafion by working at temperatures between 80 and 120 °C, is raising. This work proposes the design of a simple and reproducible method to combine polybenzimidazole (PBI) and graphene oxide (GO) in composite membranes. Five PBI:GO (X:Y) mass ratios are studied, corresponding to GO mass contents one order of magnitude higher than those typically reported in literature. The main aim is to determine if the properties of PBI and GO can be successfully blended in the produced self-assembled membranes.

The preparation of the PBI/GO composite membranes (Figure 1) relies on the magnetic mixing (1000 rpm, 1 hour, room temperature) of 2 wt% PBI-in-dimethyl sulfoxide (DMSO) and 1 wt% GO-in-DMSO solutions, up to the obtainment of homogenous slurries. The slurries are then casted onto Petri dishes and oven-dried at 90 °C for a minimum of 3 hours. The self-assembled membranes are recovered as intact products by simple detachment from the support.

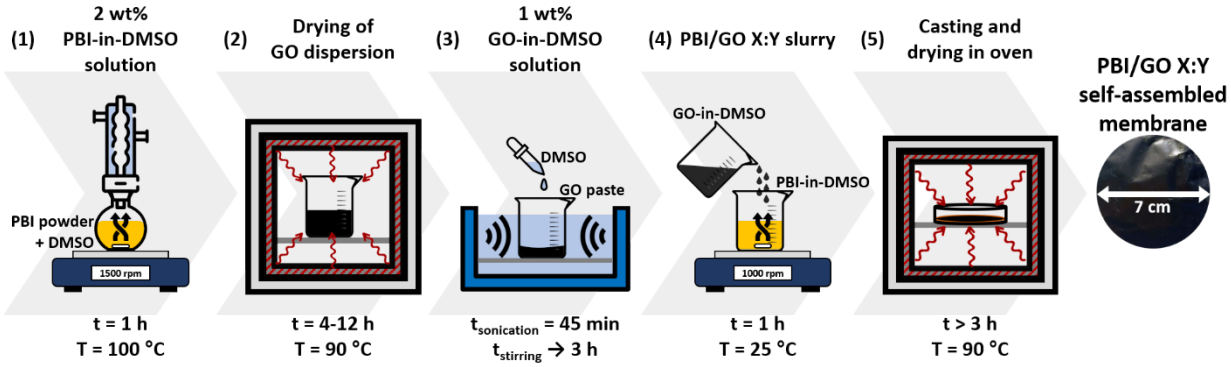

Figure 1. Preparation procedure of the PBI/GO X:Y composite membranes.

The designed preparation procedure is regarded as reliable due to the homogeneity of all the samples, likely related to an adequate reciprocal dispersion of the constituents, as indicated by SEM inspection. XRD patterns suggest an alternated stacked framework via mutual π-π interactions between the benzimidazole rings of PBI and the aromatic domains of GO. The presence of PBI enhances the thermal stability of the composites with respect to

pure GO below 130 °C. Higher tensile strengths and Young's moduli are recorded for the composites with respect to pure PBI, at the cost of lower maximum strains. Higher IEC values than virgin GO and Nafion are measured at larger GO mass contents. Proton conductivities extrapolated from EIS tests are promising, especially at 100 °C, thanks to the positive influence of the hydrophilic oxygenated functionalities of GO.