Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information for

β-cyclodextrin Modified Silica Nanoparticles for Nafion Based Proton Exchange Membranes with Significantly Enhanced Transport Properties

Wei Jia, Kai Feng, Beibei Tang* and Peiyi Wu*

State Key Laboratory of Molecular Engineering of Polymers, Collaborative Innovation Center of Polymers and Polymer Composite Materials, Department of Macromolecular Science and Laboratory of Advanced Materials, Fudan University, Shanghai 200433, the People's Republic of China.

Characterizations of 6-OTS-β-CD

As the FTIR spectrum of 6-OTS-β-CD shown in Fig.1 (a), the peak at 3386cm^{-1} and 1641 cm^{-1} are attributed to the stretching vibration and the bending vibration of O-H groups respectively [1]. The absorbance around 1157cm^{-1} is ascribed to the stretching vibration of C-O-C and the significant peak at 1029cm^{-1} is related to the stretching vibration of C-C. According to the FTIR spectrum, the peak at 1452cm^{-1} corresponding to the aromatic ring is a strong demonstration that it is successful to obtain the target modified product [1]. Furthermore, the TGA results shown in Fig 1 (b) also confirms the successful synthesis of 6-OTS-β-CD since it begins to degrade at 180 ^{o}C and reaches its fastest degradation rate at 210 ^{o}C. This phenomenon reveals that the benzene ring is out of the cavity of β-CD as a 6-substiution rather than a 2-substitution [2].

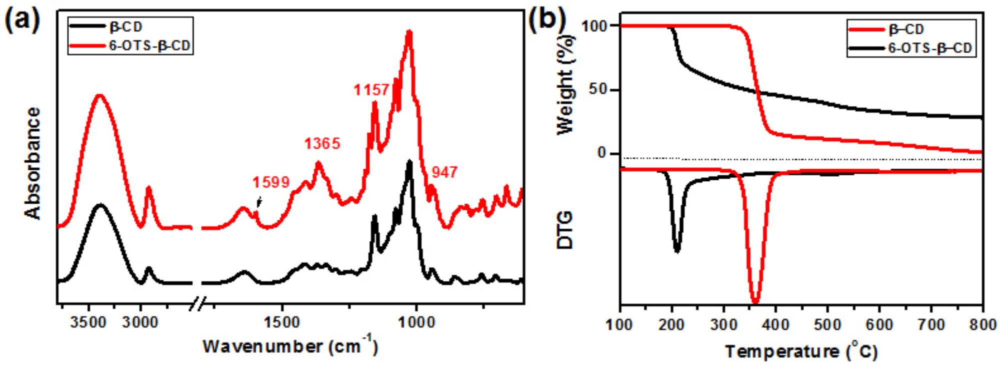

Fig. S1 (a) FT-IR spectra and (b) TGA analyses (N_2, 20°C·min^{-1}) of 6-OTS-β-CD and β-CD

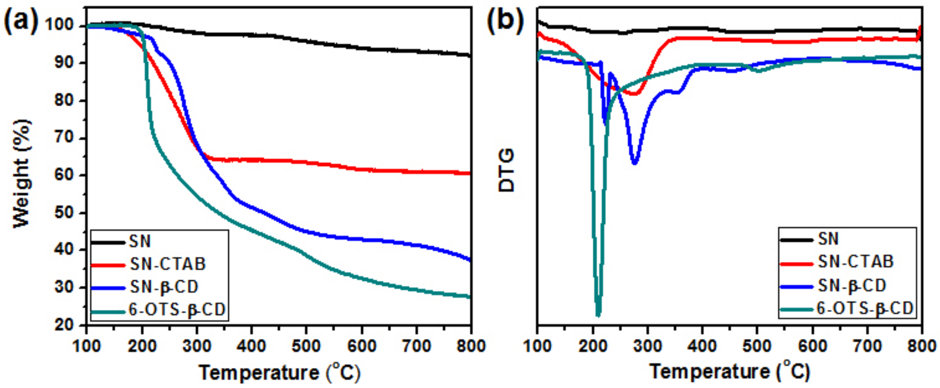

Fig. S2 TGA (a) and DTG (b) curves of SN, SN-CTAB, SN -β-CD and 6-OTS-β-CD.

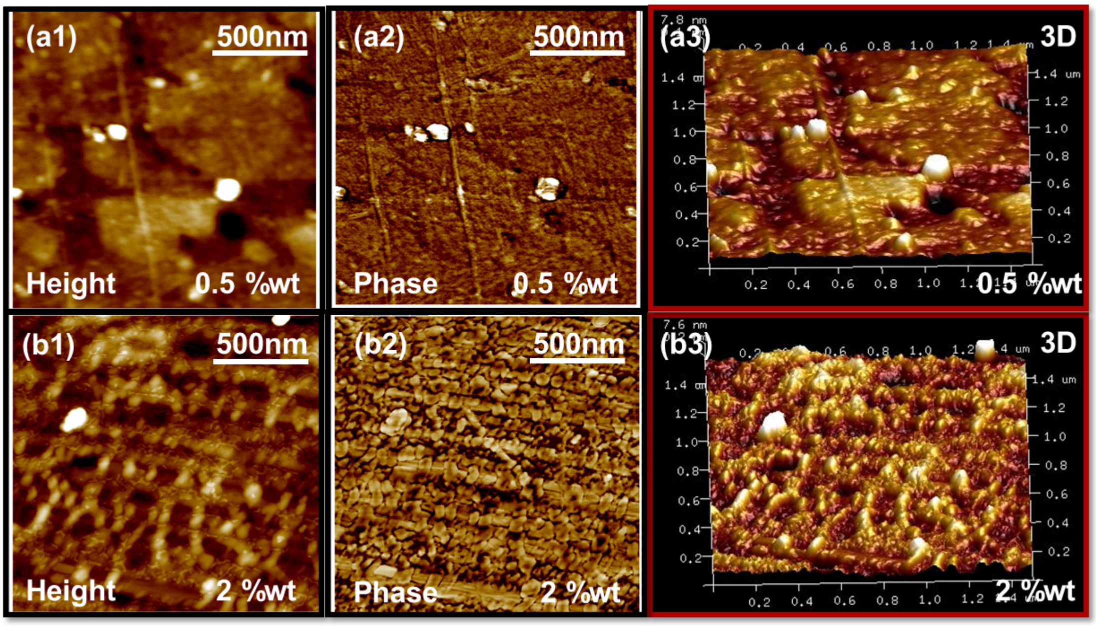

Fig. S3 2D-height and phase AFM images of (a1-a2) 0.5 wt% SN-β-CD/Nafion and (b1-b2) 2 wt% SN-β-CD/Nafion. Corresponding 3D-AFM images of (a3) 0.5 wt% SN-β-CD/Nafion and (b3) 2 wt% SN-β-CD/Nafion.

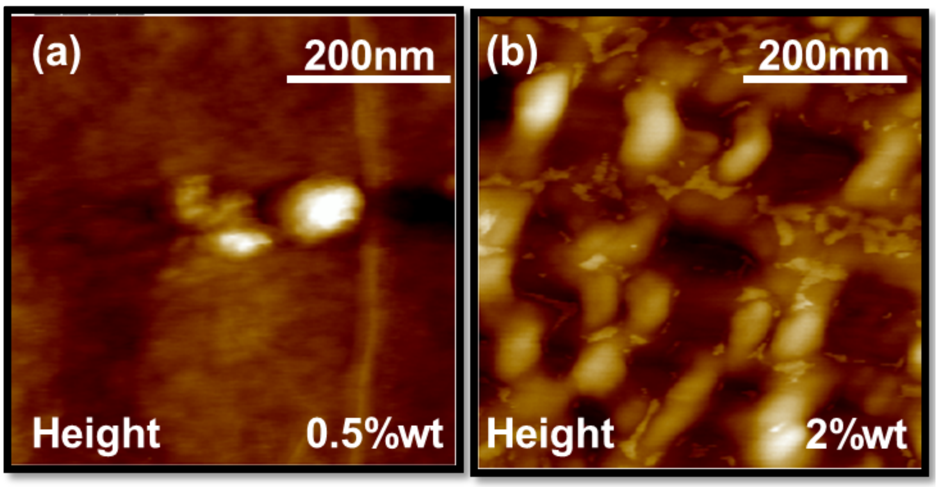

Fig.S4 Magnified 2D-height AFM images of (a) 0.5 %wt SN-β-CD/Nafion and (b) 2 %wt SN-β-CD/Nafion.

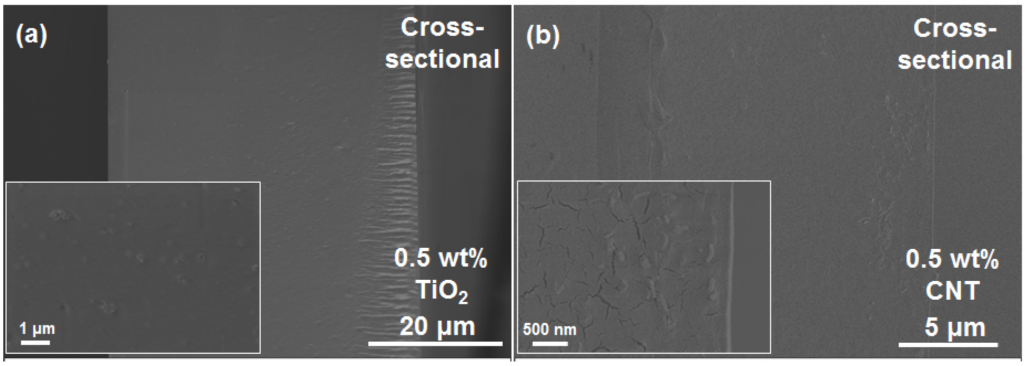

Fig.S5 SEM images of (a) 0.5 %wt TiO_2/Nafion and (b) 0.5 %wt CNT/Nafion.

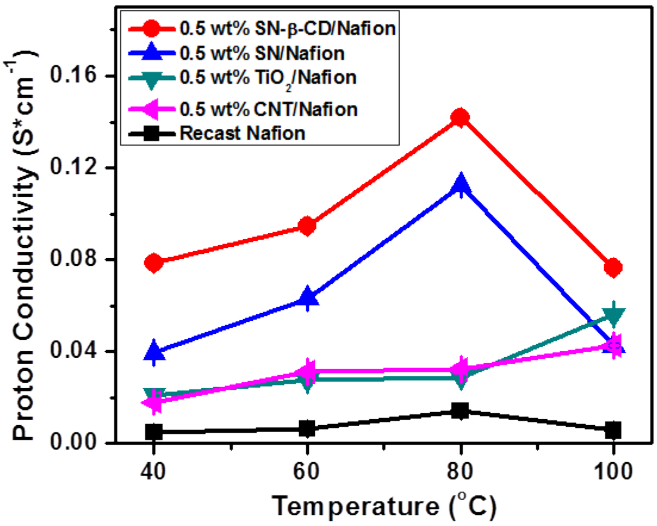

Fig.S6 Temperature-dependent (40 RH%) proton conductivity of recast Nafion, 0.5 wt% SN-β-CD/Nafion, 0.5 wt% SN/Nafion, 0.5 wt% TiO_2/Nafion and 0.5 wt% CNT/Nafion composite PEMs.

Table S1 Transport properties of recast Nafion, 0.5 wt% SN-β-CD/Nafion, 0.5 wt% SN /Nafion, 0.5 wt% TiO_2/Nafion and 0.5 wt% CNT/Nafion at 50 °C.

PEMs	**Permeability 50 °C ($cm^2 \cdot s^{-1}$)**	**Selectivity 50 °C ($S \cdot s \cdot cm^{-3}$)**
Recast Nafion	1.66E-06	3.95E+04
0.5 wt% SN-β-CD/Nafion	1.41E-08	6.80E+06
0.5 wt% SN /Nafion	1.90E-08	3.45E+06
0.5 wt% TiO_2 /Nafion	2.61E-08	2.57E+06
0.5 wt% CNT /Nafion	6.69E-09	5.55E+06

1. Y. Chen, Y. Ye, R. Li, Y. Gao and H. Tan, *FIBERS AND POLYMERS*, 2013, **14**, 1058-1065.

2. Y. Chen, Y. Ye, L. Wang, Y. Guo and H. Tan, *J Appl Polym Sci*, 2012, **1252**, E378-E383.