Nafion-Modified PEDOT:PSS/c-Si Solar Cells

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Introduction: We demonstrate the chemistry of amphiphilic perfluorosulfonic copolymer Nafion-coated conductive PEDOT:PSS and its effect on the photovoltaic performance of PEDOT:PSS/Si heterojunction solar cells. In this study, solution-processed Nafion-modified PEDOT:PSS/c-Si heterojunction solar cells exhibited a higher power conversion efficiency over 14% with better stability for light soaking rather than the pristine device by adjusting the layer thickness of Nafion.

Experiment: N-type CZ c-Si wafers (0.1-0.3 Ω·cm, 300 μm thickness) were used as a substrate. They were cleaned by organic solvents followed by HF etching (5%, 2 min) to remove native oxide. Commercialized PEDOT:PSS (Clevios PH1000) using EG(7wt%) and Zonyl(0.2wt%) as dopants was spin coated at 2500 rpm for 30s followed by thermal annealing at 140 ˚C for 20 min. Subsequently, Nafion solutions with different concentrations diluted in isopropyl alcohol (IPA) were spin coated at 2000 rpm on top of the samples, followed by annealing at 140 °C for 10 min. The corresponding layer thickness of Nafion were 30, 100, and 200 nm, respectively. Nafion-doped PEDOT:PSS films were also fabricated by spin coat using blended solution of Nafion and PEDOT:PSS in different weight ratios. The Nafion-modified PEDOT:PSS films were characterized using spectroscopy ellipsometry, XPS, micro-Raman spectroscopy, and SEM.

Conclusion: As **Fig. 1** shown, the photovoltaic performance of Nafion-coated PEDOT:PSS devices exhibited a better performance with improved stability for light soaking compared to the pristine PEDOT:PSS device. These findings originate from following contributions, i.e., 1) Increased carrier mobility due to the extension of π-conjugation of PEDOT, 2) the resistance of the moisture and impurity due to Nafion layer, 3) Nafion over layer acts as an antireflection layer and 4) Silver paste as a top grid electrode diffuse and/or preferentially dissolved with Nafion, resulting in a good contact with underneath Nafion-modified PEDOT:PSS.

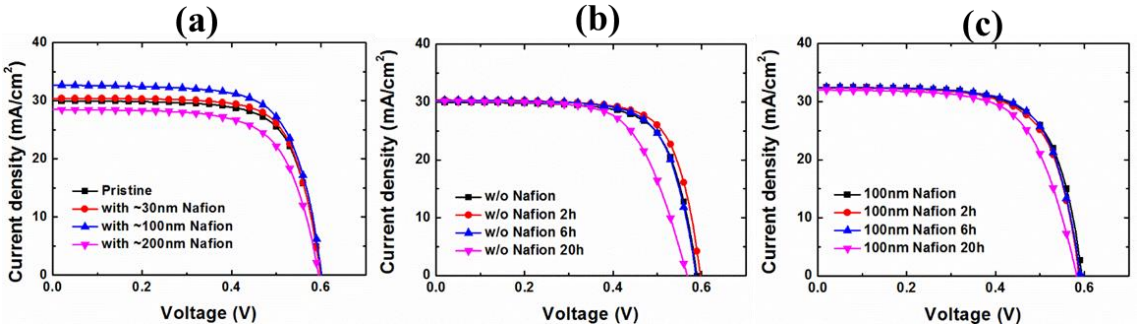

Figure 1. (a) Photovoltaic performance of PEDOT:PSS/c-Si devices coated by Nafion layer with different thickness. Light soaking test of (b) pristine and (c) 100nm Nafion coated device under AM1.5 simulated solar light.

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