Supporting Information

Enhanced Photoresponse in Dye-Sensitized Solar Cells via Localized Surface Plasmon Resonance through Highly Stable Nickel Nanoparticles

Md. Mahbubur Rahman^a, Sang Hyuk Im^b, and Jae-Joon Lee^{a*}

^aNanotechnology Research Center & Department of Applied Life Science, College of Biomedical and Health Science, Konkuk University, Chungju 380-701, Korea

^bDepartment of Chemical Engineering, Kyung Hee University, Yongin 446-701, Republic of Korea

*Corresponding Author : E-mail, jjlee@kku.ac.kr; Fax: +82-43-851-4169; Tel : +82-43-840-3580

Materials

Nickel sulphate heptahydrate (NiSO₄.7H₂O), sodium borohydride (NaBH₄), sodium hydroxide (NaOH), and tetra-butyl ammonium hexafluorophosphate (TBAPF₆) were purchased from Sigma-Aldrich and used as-received. The electrolytes were prepared by dissolving 0.6 M 1,2-dimethyl-3-propylimidazolium iodide (DMPII, Solaronix SA) in acetonitrile (ACN):valeronitrile (VLN) (85:15 v/v) along with 0.1 M lithium iodide (LiI), 0.1 M iodine (I₂), and 0.5 M 4-tertbutylpyrindine (TBP) as an additive.

Optimization of the amount of NiNPs

Different amounts of NiNPs (1–4 mg/mL) were mixed with I^-/I_3^- electrolyte (NiNPs@ I^-/I_3^-). The *J-V* parameters of NiNPs@ I^-/I_3^- incorporated DSSCs (NiNP-DSSC) are summarized in Figure S1. The highest PCE was obtained with 1 mg/mL of NiNP in NiNPs@ I^-/I_3^- and the PCE was decreasing at higher content of NiNPs. It was partly attributed to the role of NiNPs as a recombination center during operation at high concentration.^{S1} Further, the domination of the light absorption over dyes by the high contents of NiNPs in NiNPs@ I^-/I_3^- would not be favorable for overall energy harvesting because of the light absorption by NiNPs is quite strong and over the entire optical absorption range of N719. Thus, 1 mg/mL of NiNP is chosen as the optimal amount to prepare NiNPs @ I^-/I_3^- .



Figure S1: Photocurrent density-voltage (*J-V*) characteristics of DSSCs with different amount of NiNPs@ I^{-}/I_{3}^{-} electrolyte. The thicknesses of photoelectrodes were *ca*. 2 µm.



Figure S2: Stability data of J_{sc} for R-DSSC and NiNP-DSSC, measured periodically for 121 h under 1sun illumination. The TiO₂ photoanode thickness for both R-DSSCs and NiNP-DSSC were *ca*. 5 µm, which were sensitized by N719 dye.

Reference

S1. M. D. Brown, T. Suteewong, R. S. S. Kumar, V. D'Innocenzo, A. Petrozza, M. M. Lee, U. Wiesner and H. J. Snaith, *Nano Lett.*, 2011, 11, 438–445.