A morphological study of solvothermally grown SnO_2 nanostructures for application in perovskite solar cells

Zhuldyz Yelzhanova[1], Gaukhar Nigmetova[2], Damir Aidarkhanov[1], Bayan Daniyar[1], Bakhytzhan Baptayev[3], Mannix P. Balanay[4], Askhat N. Jumabekov[5] and Annie Ng[1*]

[1]*Department of Electrical and Computer Engineering, School of Engineering and Digital Sciences, Nazarbayev University, Kabanbay Batyr Ave. 53, Nur-Sultan 010000, Kazakhstan;*

[2]*Department of Chemical and Materials Engineering, School of Engineering and Digital Sciences, Nazarbayev University, Kabanbay Batyr Ave. 53, Nur-Sultan 010000, Kazakhstan;*

[3]*National Laboratory Astana, Kabanbay Batyr Ave. 53, Nur-Sultan 010000, Kazakhstan;*

[4]*Department of Chemistry, School of Sciences and Humanities, Nazarbayev University, Kabanbay Batyr Ave. 53, Nur-Sultan 010000, Kazakhstan;*

[5]*Department of Physics, School of Sciences and Humanities, Nazarbayev University, Kabanbay Batyr Ave. 53, Nur-Sultan 010000, Kazakhstan;*

*E-mail: annie.ng@nu.edu.kz

SnO_2 is considered as one of the most effective electron transport materials used in solar cells. It has promising intrinsic properties such as wide bandgap, high electron mobility, high carrier transportation, and chemical stability. The majority of perovskite solar cells (PSCs) based on SnO_2 electron transport layers (ETL) is in the form of SnO_2 nanoparticles or quantum dots. The PSCs based on other SnO_2 nanostructured ETL show a large discrepancy in power conversion efficiency (PCE). One of the reasons is that the preparation of nanostructures is very sensitive to different growth factors, resulting in low reproducibility. Thus, the aim of this work is to empirically investigate the growth parameters of solvothermally grown SnO_2 nanorod arrays (NAs). It is noteworthy that the processing parameters such as growth pressure, substrate orientation, deionized (DI) water-to-ethanol ratio, types of seed layer, amount of acetic acid, and growth time have strong correlations with each other. For this reason, every parameter should be individually optimized. This work demonstrates the morphological control of solvothermally grown SnO_2 NAs by the systematic investigation of various growth parameters. This presentation will show the trend of morphological changes of SnO_2 nanostructure based on the obtained results. The outcomes present information, which provides the direction for future preparation of more reproducible SnO_2 nanomaterials for PSCs.

Acknowledgement

This research was supported by A. N. thanks Scientific Research Grant from Ministry of Education and Science of the Republic of Kazakhstan (grant no. AP08856931); Collaborative Research Grant from Nazarbayev University (grant no. 021220CRP0422) and the social policy grant. A. N. J. acknowledges Nazarbayev University Collaborative Research Grant (grant no. 021220CRP1922)