উচ্চতর বিজ্ঞান গবেষণা কেন্দ্র (কারস্)
ঢাকা বিশ্ববিদ্যালয়
ঢাকা - ১০০০

Centre for Advanced Research in Sciences
University of Dhaka
Dhaka-1000

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CARS SEMINAR SERIES

Speaker: **Dr. Md. Shahiduzzaman**
Assistant Professor (Tenure Track)
Nanomaterials Research Institute (NanoMaRi)
Kanazawa University
Japan

Title: **Perovskite Solar Cells: A Promising Future of Solar Photovoltaic**

Venue: Conference Room (1st Floor), Center for Advanced Research in Sciences (CARS), University of Dhaka

Date: Thursday, 2 May, 2024

Time: 11.00 am

You are cordially invited to attend the seminar.

Ishtiaque M Syed, PhD
Professor of Physics &
Director
Centre for Advanced Research in Sciences (CARS)
University of Dhaka.

Prof. Dr. Ishtiaque M. Syed
Director
Centre for Advanced Research in Sciences
University of Dhaka, Dhaka-1000

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Perovskite Solar Cells: A Promising Future of Solar Photovoltaic

Dr. Md. Shahiduzzaman
Assistant Professor (Tenure Track), Nanomaterials Research Institute (NanoMaRi)
Kanazawa University, Japan

Abstract: Japanese government's decarbonization strategy aims to achieve carbon neutrality by 2050. Solar photovoltaic (PV) can directly harness the power of the Sun by turning sunlight into electricity. The main forms of PV cells used commercially are silicon (Si) solar cells, which requires high processing costs and energy-demanding facilities to fabricate. These costs and energy must be quickly reduced to accelerate the transition to a low-carbon economy. This will involve the use of novel materials that are less expensive, lighter in weight, and more flexible than silicon (power conversion efficiency (PCE) of 26.8%).

As such, organic-inorganic hybrid halide perovskite came to light as a new class of solar cells with the PCE of 26.1% is already at the level of commercialization.[1] Still, long-term operational stability has become a major concern owing perovskite's intrinsically soft ionic crystal structures. Very recently, we used the ionic liquid (IL) aided-$CH_3NH_3PbI_3$ ($MAPbI_3$) perovskite nanoparticles (NPs) as a seeded-growth approach to fabricate high moisture-stable perovskite solar cells with a PCE of around 20%.[2] It retained above 80% of its initial output even after 6000 hours of storage at ambiance with relative humidity (RH) range of 30–40% (non-encapsulated). In the first half, we found that IL-aided $MAPbI_3$ NPs form in the grain boundary of the CsFAMA perovskite crystal domains. This implies that the embedding of IL-aided $MAPbI_3$ NPs in the CsFAMA perovskite crystal domain showed increased hydrophobicity (water contact angle of 72.3°) than pristine CsFAMA (water contact angle of 54.1°) by repelling moisture and preventing drop water infiltration under humid conditions.

In the second half, I will talk about cesium halides (CsX: CsCl, CsBr, CsI) intercalation technology for efficient and stable PSCs. Previously, we intercalated vacuum deposited cesium iodide (CsI) into solution processed host $MAPbI_3$ perovskite framework and achieved a PCE of 18.43% and remained above 80% of their initial output after 6000 h storage in open air (non-encapsulated) for the first time.[3] In this study, we introduced vacuum deposited CsX (CsCl, CsBr and CsI) thin layers into solution processed host $MAPbI_3$ perovskite film from the up, down or both layers to promote precise intercalation, resulted in high-quality perovskite film for high stable PSCs. The use of CsX layer greatly altered the $MAPbI_3$ morphology to produce large grain sizes, as a result of the precise intercalation of the CsX molecules into the host $MAPbI_3$. We tested moisture stability for 3000 h storage at ambient with a RH range of 50–60% (non-encapsulated), Cs-containing perovskite films showed higher stability (no color changed, retained black) than pristine $MAPbI_3$ film (color changed and degraded).

Bibliography: Dr. Md. Shahiduzzaman is an Assistant Professor (Tenure Track) at the Nanomaterials Research Institute (NanoMaRi) in Kanazawa University, Japan, where he designs, fabricates, and develops highly efficient and stable perovskite solar cells (PSCs). Born in Bangladesh in 1982, Dr. Shahiduzzaman moved to Japan for postgraduate study in 2011. He obtained a Master's degree in Thermoelectric Materials & Application from Japan Advanced Institute Science & Technology (JAIST) in 2013 and did his Ph.D. on PSCs from Kanazawa University in 2016. Then, twice he did post-doctoral before joining at NanoMaRi. He was an Assistant professor (Fixed Term) up to October 2022. He is also working as a visiting professor at Waseda University and Tokai University (Shonan Campus) in Japan since 2019. Dr. Shahiduzzaman aims to create groundbreaking seed technology of PSCs for large-scale practical application with the goal of unlocking net-zero carbon emissions by 2050 and promoting local economic growth for sustainable future. He delivered over 50 as a keynote/invited speaker and over 30 oral/poster in international/domestic conferences/seminar. He wrote over 40 manuscripts as a first and corresponding author. He published 4 book chapters, 6 Japanese patents and over 100 peer-reviewed articles until the date.