

Fiscal Year 2016, Tokyo Institute of Technology ASPIRE League Research Grant

Selected Research Project for Type 1 in FY2016

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	Position	Professor
Co-researchers	HKUST	Shihe Yang, Professor Department of Chemistry
	KAIST	Byungha Shin, Assistant Professor Department of Materials Science and Engineering
	NTU	Nripan Mathews, Assistant Professor Department of Materials Science and Engineering
	Tsinghua	Hong Lin, Professor School of Materials Science and Engineering
Subject of the research project		High-throughput Creation of Ideal Interfaces of Commercially-applicable Organic-Inorganic Hybrid Perovskite Solar Cells
Summary of the research project		The mesoscopic organic-inorganic hybrid solid-state solar cell based on organic and inorganic semiconductors (SC) combined with perovskite crystals (perovskite cell) is a highly attractive subject due to its high conversion efficiency, >20% (certified in NREL), and ease of production based on printable processes. The challenges in developing this solar cell are proposed as 1) construction of ideal interfaces for more efficient charge transfer, 2) stable photon-absorber in ambient condition, and 3) alternative semiconducting and photon-absorbing materials to replace Pb in perovskite derivatives. The results of the preceding collaborative research on dye-sensitized solar cells (DSSCs) among the laboratories of organic chemistry, materials sciences, and physical chemistry in our department in Tokyo Tech will be extensively applied to the perovskite cell that shares

<p>Summary of the research project</p>	<p>common meso-porous n-type semiconductor, TiO<sub>2</sub>, for efficient charge separation and transport. In addition, the analytical techniques of charge transfers at interfaces established in the DSSC area can also be applied to further understanding those of the perovskite cell. The principal researcher's pioneering work on microwave (MW) chemistry can also be applied to the construction of well-ordered and crystalline phase of perovskite with hybrid SC with fewer defects in the crystals that would affect the device stability and reproducibility. The collaborators from each university in ASPIRE League, namely, Tsinghua Univ., Nanyang Tech., KAIST, and HKUST, will focus on three subjects in this project: 1) printable perovskite-based hybrid SC without toxic Pb compounds, 2) highly stable and low-cost hole transport layer, and 3) highly-reactive carrier transport interface created by interface microwave processing. The collaborators are expected to exchange ideas and materials necessary for the above subjects. The interfacial charge transfer properties are examined to provide feedback for further materials development. We will also collaborate to establish the standard techniques for evaluating device characteristics, which now varies lab-to-lab and sometimes leading to erroneous ideas about the characteristics of solar cells. This group will play a leading role in developing the perovskite solar cell in not only Asia, but also in the world-wide research collaborations by connecting us with US and EU societies of perovskite researches.</p>
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