Fiscal Year 2015 Tokyo Institute of Technology ASPIRE League Research Grant

Selected Research Projects for Type 2 in FY2015

Principal Researcher	Name	**Yuji Wada**
	Department and graduate school(institute) in Tokyo Tech	Department of Applied Chemistry, Graduate School of Science and Technology
	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

Summary of the research project	common meso-porous n-type semiconductor, TiO2 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 which affect the device stability and reproducibility. The co-researchers from each university in the ASPIRE League, Tsinghua University, Nanyang Technological University, KAIST, and HKUST will focus on the three subjects in this project as listed below, 1) printable perovskite-based hybrid SC without toxic Pb compounds, 2) highly stable and low-cost hole transport layer, and 3) high throughput low-temperature process of films creation by means of the MW-processing for fabrication. The co-researchers are supposed to exchange ideas and materials necessary for the three subjects. The interfacial charge transfer properties are examined to provide feedback for further materials development. We also collaborate to establish standard techniques for evaluating the device characteristics which now vary lab-to-lab, sometime misleading the characteristics of solar cells. This group will play a leading role in developing the perovskite solar cell in Asia.