**Perovskite Solar Cells and Photocatalysis**

**Eric Wei-Guang Diau\*, Ming-Chou Chen, Chun-Hsiao Kuan**

aDepartment of Applied Chemistry, and Institute of Molecular Science National Yang Ming Chiao Tung University 1001 Ta-Hseuh Rd., Hsinchu 300093, Taiwan

E-mail: [diau@nycu.edu.tw](mailto:diau@nycu.edu.tw)

**Abstract**

Tin-based perovskite solar cells (TPSCs) have emerged as promising alternatives to lead-based perovskites due to their lower toxicity, tunable optoelectronic properties, and potential for tandem applications. However, their commercial viability remains hindered by rapid oxidation of Sn²⁺, uncontrolled crystallization kinetics, phase segregation, and interfacial instability, which limit their efficiency and long-term stability, in particular to use PEDOT: PSS as HTL for TPSCs. To overcome these challenges, we have applied self-assembled monolayers (SAMs) to replace PEDOT:PSS using a two-step fabrication method developed by our group.1 The SAM molecules were designed to have a D-D-A structure, for which the head donor group (interacting with perovskite) is a triphenylamine (TPA) unit and the end acceptor group (anchoring on NiOx/ITO surface) is either -CN, -COOH, -PO3H2, or PO3E2 unit. The central donor group can be Thienopyrazine (TP) to attain PCE 7.7%,2 Y-shaped TPA to attain PCE 8.1%,3 Bithiophene Imide (BTI) to attain PCE, 8.6%,4 or I-shaped Selenophene (Sp) to attain PCE 8.7%.5 We will also present a PTAA-based all perovskite tandem solar cell to attain PCE 28.1%. A quadruple-cation mixed-halide TPSC with bandgap 1.93 eV to attain PCE 6.2% will be reported.6 On the other hand, photocatalytic CO2 reduction to generate CO will be presented with the photocatalysts of Zinc Indium Sulfide (ZIS),7 water-stable pseudohalide perovskites,8 and a S-scheme PeNC/BiVO4 heterojunction system.9 For water splitting, the H2 product yields were reported to give 17.1 mmol g-1 h-1 for Al-doped ZnS, 24.5 mmol g-1 h-1 for BiH4-modified SrTiO3 and 38.5 mmol g-1 h-1 for NH4Cl-modified K-PHI. Our promising results thus highlight the significance of using solar energies to produce electricity via efficient perovskite solar cells and solar fuels via efficient photocatalysts developed by our team.

**References**

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