

Yun-Shuo Liu

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EDUCATION

Soochow University

◆ B.S., Department of Chemistry

Taipei, Taiwan

Sept. 2021 – Jun. 2024

University of Houston

◆ M.S., Department of Chemistry

Texas, USA

Aug. 2025 – Now

RESEARCH EXPERIENCE

Organic Photoelectric Material Lab

◆ Bachelor Thesis

Taipei, Taiwan

Sept. 2022 – Sept. 2023

1. Hole-transporting material on perovskite solar cell

- **Fluorination of star-shaped cyclopenta [2,1-b;3,4-b 0] dithiophene derivatives and its application as hole-transporting materials in scalable perovskite solar cell fabrication by bar coating**
 - Three novel star-shaped small molecules are designed and synthesized in series and applied in perovskite solar cells (PSCs) as efficient hole-transporting materials (HTMs). Adding a fluorine atom to the compound can enhance hole mobility, the extraction/transport capability, increase hydrophobicity, and have a better passivation effect. A large-scale cell using the thermal-assisted bar-coating (TABC) method demonstrates its commercial value.
- **Judicious molecular design of 5H-Dithieno[3,2-b:2',3'-d] pyran (DTP) -based hole-transporting materials for highly efficient and stable Perovskite Solar Cells**
 - Different functional groups are substituted on the DTP unit and are used for fabricating PSCs. Notably, the incorporation of trifluoromethyl groups in CF₃-H endows the molecule with a larger dipole moment, deeper highest occupied molecular orbital (HOMO) energy level, better film morphology, closer molecular stacking, more efficient defect-passivation, enhanced hydrophobicity, and better photovoltaic performance compared with the Ph-H counterpart. Fluorine-substituted triphenylamine shows impressive power conversion efficiency (PCE) and exhibits excellent long-term stability.
- **2024 Chemistry National Meeting** Mar. 2024
- **2024 Campus Poster Competition** Apr. 2024

2. Self-assembled-monolayer on inverted perovskite solar cell

Feb. 2023-Now

- **Co-Assembly with Donor-Acceptor Self-Assembled Monolayers to Enhance Interfacial Hole Extraction, Wettability and Crystallization in Inverted Perovskite Solar Cells**
 - We designed two donor-acceptor (D-A) self-assembled materials (SAMs) termed LYS-H and its

fluorinated analogue LYS-F and co-assembled them with the widely used Me-4PACz (Me4) as hole-selective contacts (HSCs) for inverted perovskite solar cells (PVSCs). The synergistic interactions between Me4 and the LYS derivatives promote favorable molecular stacking, improve surface wettability, and enhance perovskite crystallization, thereby reducing interfacial non-radiative recombination. Ultimately, the co-assembled devices exhibit excellent fill factors (FF) and high-power conversion efficiency (PCE), while significantly improving operational stability.

SKILLS

- ◆ **Chemistry experiments:** General chemistry lab, organic chemistry lab, analytical chemistry lab, physical chemistry lab
- ◆ **Chemistry analysis:**
 1. Voltammetry: Using differential pulse voltammetry and cyclic voltammetry to measure compound's redox potential and calculate its highest occupied molecular orbital (HOMO)
 2. Spectroscopy:
 - Ultraviolet-visible fluorescence spectroscopy: Measuring compound's absorption and emission wavelength range and energy gap calculation
 - Infrared spectroscopy: Measuring spectra shifting to identify compound and substrate's functional group interaction
 3. Water-contact angle analysis: Determining the compound's hydrophilicity or hydrophobicity
 4. Powder X-ray diffraction analysis: Identifying compound's crystallinity
 5. Column Chromatography
- ◆ **Organic synthesis:**

Suzuki coupling, Bromination, Palladium coupling reaction, Alkylation, Ullman reaction, Condensation, Grignard reagent reaction, Aldol reaction, n-butyl lithium reaction...
- ◆ **Fabrication experiments:**
 1. Using spin coating and split coating in filmmaking
 2. Deposit techniques
 3. Surface morphology analysis: Scanning electron microscope, Atomic force microscope
 4. X-ray photoelectron spectroscopy:

Measuring the shifting of the binding energy of elements and detecting the passivation and interactions between substrates
 5. Photoluminescence
- ◆ **Grazing-Incident Wide-Angle X-Ray Scattering (GIWAXS):**

Using GIWAXS to identify intermolecular interaction and packing information and structure presentation of the compounds

◆ **Theoretical Calculation**

Using theoretical calculation to model molecule structure and to predict and explain the molecule properties and the instrumental results