

# Kai Outlaw-Spruell

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## PROFESSIONAL EXPERIENCE

### Junior Researcher

*April 2022-Present*

*Hawaii Natural Energy Institute*

*Honolulu, HI*

Responsible to identify and evaluate material systems and interfaces to progress novel integration and encapsulation methods for enhancement and protection of active photovoltaic (PV) and photoelectrochemical (PEC) systems. Directly involved in laboratory research, materials technology development, participate in project review address specific technical problems, process and design analysis while performing as a technical consultant for proposal writing by identification and advancement of anticipated research needs.

- Advancement of perovskite material encapsulation technology demonstrating 9x the performance of state-of-the-art for photoelectrochemical water-splitting for hydrogen production in sulfuric acid (Mar, 2022) leading to US Department of Energy research funding (DOE SETO)
- Modeling load and strain across conductive media and photovoltaic material to facilitating a project proposal direction pertaining to strain engineering of 2D materials (DOE EPSCoR)
- Demonstrated the world's first triple-junction all-CIGS device through the semi-monolithic device integration method
- Development of a finite element electrical model for power loss analysis to engineer large-area semi-monolithic tandem devices interfaces with negligible electrical losses

### Research Assistant

*Mar 2020-April 2022*

*Hawaii Natural Energy Institute*

*Honolulu, HI*

Responsible for the research and development material systems, thin film deposition processes optimization and conducting performance verification in an effort to develop the novel semi-monolithic device integration process.

- Demonstrated a novel manufacturing process for multi-junction CIGS PV and PEC devices
- Established a mechanical model research to optimize interface assembly to increase device scale and reduce risk of failure during integration for the semi-monolithic manufacturing process
- Presented at the Materials Research Society Symposium [EN02](#) to and wrote the manuscript accepted for publication by ACS Applied Materials & Interfaces (Dec, 2022), to communicate research results
- Slashed hours of data processing time into less than a minute using MATLAB
- Material characterization using laboratory instrumentation (i.e., RAMAN, EDS, SEM)

### Mechanical Design Engineering Intern

*Jan 2019-Mar 2020*

*Makai Ocean Engineering*

*Waimanalo, HI*

Worked alongside a team of senior professional engineers to find design solutions for R&D projects.

- Created a transport cart for a phase II project, working in conjunction with the product design team
- Improved subsea micro-piler prototype by implementing air release valve to eliminate air lock issue
- Conducted literature review to identify micro-piler depth requirements, force distribution and failure modes
- Drafted and analyzed spring linkage mechanism using excel to meet operations force curve requirements
- Design analysis of reformer insulation using SolidWorks heat transfer analysis and flow simulation for selected material systems.
- Worked in the machine shop to build prototypes and test equipment

## EDUCATION

### Master of Science, Mechanical Engineering

University of Hawaii at Manoa

M.S. Thesis, *Novel semi-monolithic tandem device architecture for photovoltaic devices*, University of Hawaii, Mechanical Engineering, Spring 2021.

Spring 2021  
Honolulu, HI

### Bachelor of Science, Mechanical Engineering – Summa Cum Laude

University of Hawaii at Manoa

Awards: Student Engineer of the Year (HCES 2019), Prof. Bruce Liebert Award,  
Senior Design - Designed and built a tether management system for ROV remote deployment purposes  
EIT – Completed FE exam Aug. 2021

Spring 2020  
Honolulu, HI

## SKILLS

**Software:** SolidWorks, MATLAB, Python, Microsoft Excel, Ansys, Arduino

**Hardware:** Machine Shop, Structural Analysis, Prototyping, Material Selection, Electromechanical

**Language:** Systems English (Native level), Japanese (Native level)

## ASSISTED PROJECT FUNDING

(1) *Two-Dimensional Materials for Thin Film Manipulation in Solar Energy Conversion Devices*

**Amount awarded: \$750,000**

Agency: DOE EPSCoR

Role: Technical Lead, PI: Nicolas Gaillard

(2) *Monolithic Encapsulation of Perovskite Solar Cells with Transparent Conductive Composites for Long-Term Stability*

**Amount awarded: \$375,000**

Agency: DOE Solar Energy Technologies Office (SETO)

Role: Technical Lead, PI: Nicolas Gaillard

## PUBLICATIONS

(1) *Semi-monolithic Integration of All-Chalcopyrite Multijunction Solar Conversion Devices via Thin-Film Bonding and Exfoliation*, Outlaw-Spruell, K., Crunk, J., Septina, W., Muzzillo, C. P., Zhu, K., & Gaillard, N. (2022). *ACS Applied Materials & Interfaces*, 14(49), 54607–54615. <https://doi.org/10.1021/acsami.2c10578>

## REFERED CONFERENCE PRESENTATIONS

(1) *Semi-Monolithic Tandem Solar Cell Architecture for Photoelectrochemical Water Splitting*, K. Outlaw-Spruell, J. Crunk, W. Septina and N. Gaillard, Materials Research Society Spring Meeting, Symposium EN02, EL02.04.04, Digital Meeting, 2021.

(2) *Semi-Monolithic Chalcopyrite-Based Multijunction Solar Devices*, N. Gaillard, W. Septina, J. Crunk, K. Outlaw-Spruell and T. West, European Materials Research Society Spring Meeting, Virtual Meeting, A.II.2, (2021).

(3) *A Transparent Polymer Impregnated with Conductive Particles for Tandem Photovoltaic Devices*, J. Crunk, K. Outlaw-Spruell and N. Gaillard, Materials Research Society Spring Meeting, Joint Symposium EN07/EN06, EN07.01/EN06.01.05, Digital Meeting, 2021.