



# Translating ASU innovations into space technologies

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**ASU** Arizona State  
University

# Ira A. Fulton Schools of Engineering snapshot

**\$250M+**

annual research  
expenditures

**225+**

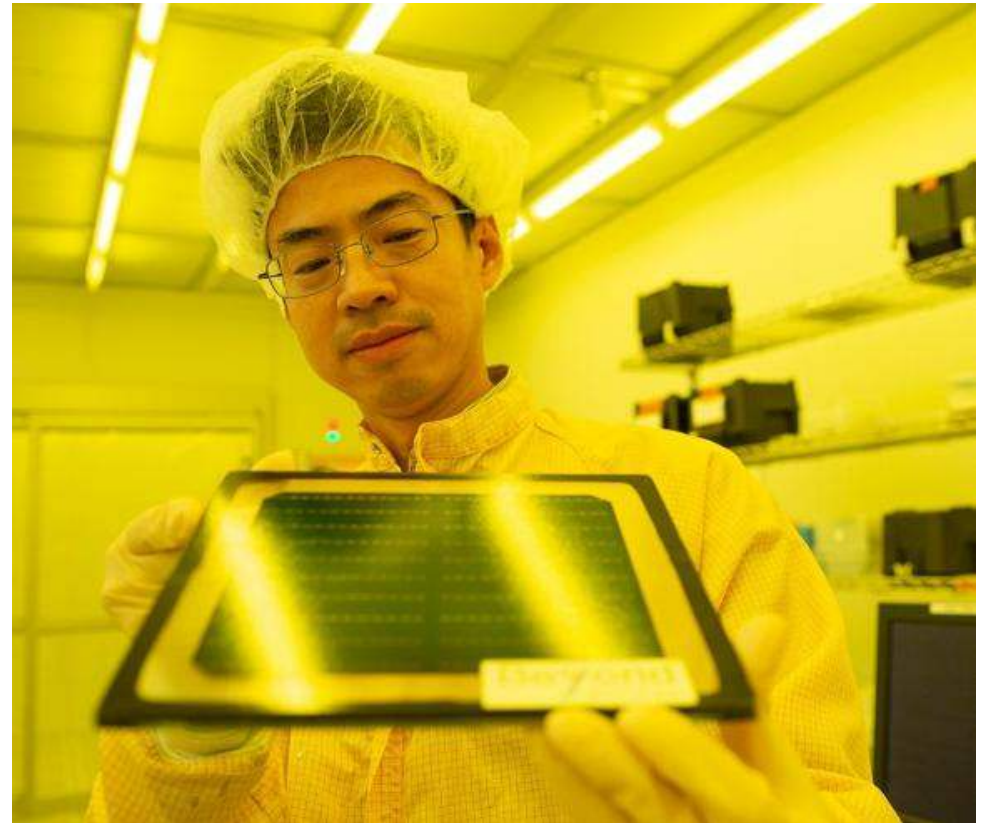
annual invention  
disclosures

**33,000+**

**students**  
estimated, in-person and  
online

**7,300+**

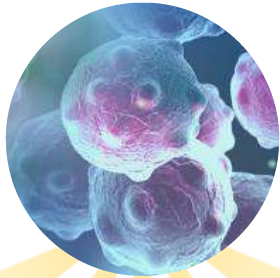
**graduates**  
across all degree levels  
in AY2024-25



# Fulton Schools five-year research impact themes

**FSE Research  
Impact Themes**

Technology-Enhanced  
Health and Medicine



Competitive Manufacturing in  
an Advanced Economy



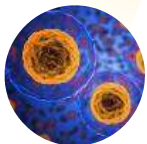
Climate Technology  
Solutions



National and Economic  
Security



**Engineered  
Embodiments**



Imaging



Cell and tissue  
engineering



Biosensors



Data



Additive  
manufacturing



Automation



Water



Solar and  
storage



Grid



Comms



Microelectronics



AI

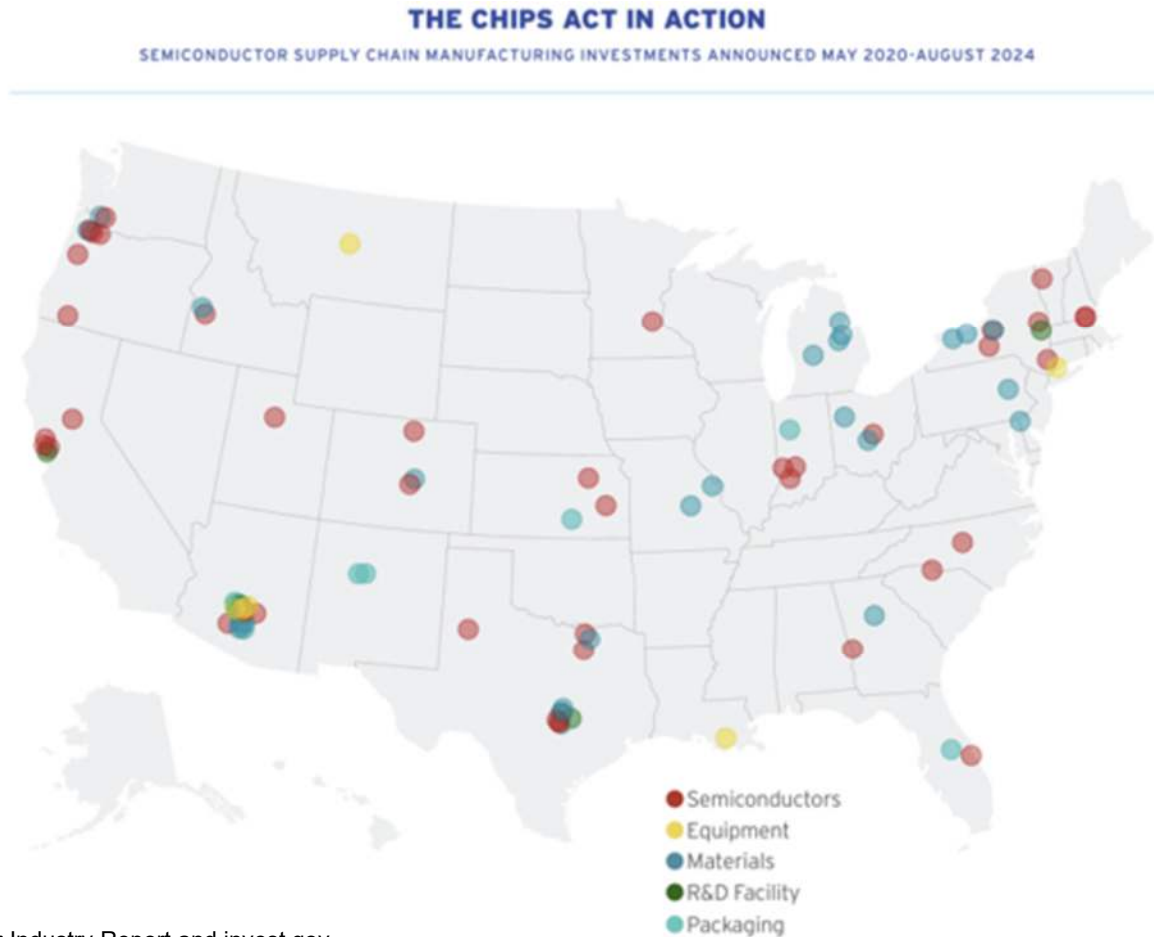


## Four steps to research impact via tech transfer

- 01 *Be disciplined about identifying strategic research areas*
- 02 *Build unique research capabilities*
- 03 *Use models that allow all innovators to access those capabilities*
- 04 *Enable—and incentivize—industry partnerships and entrepreneurship*

# Step 1: Be disciplined about identifying strategic research areas

**More than \$200 billion** in private sector semiconductor investments in Arizona since 2021



Sources: Semiconductor Industry Association 2024 State of the Semiconductor Industry Report and invest.gov

# Step 1: Be disciplined about identifying strategic research areas

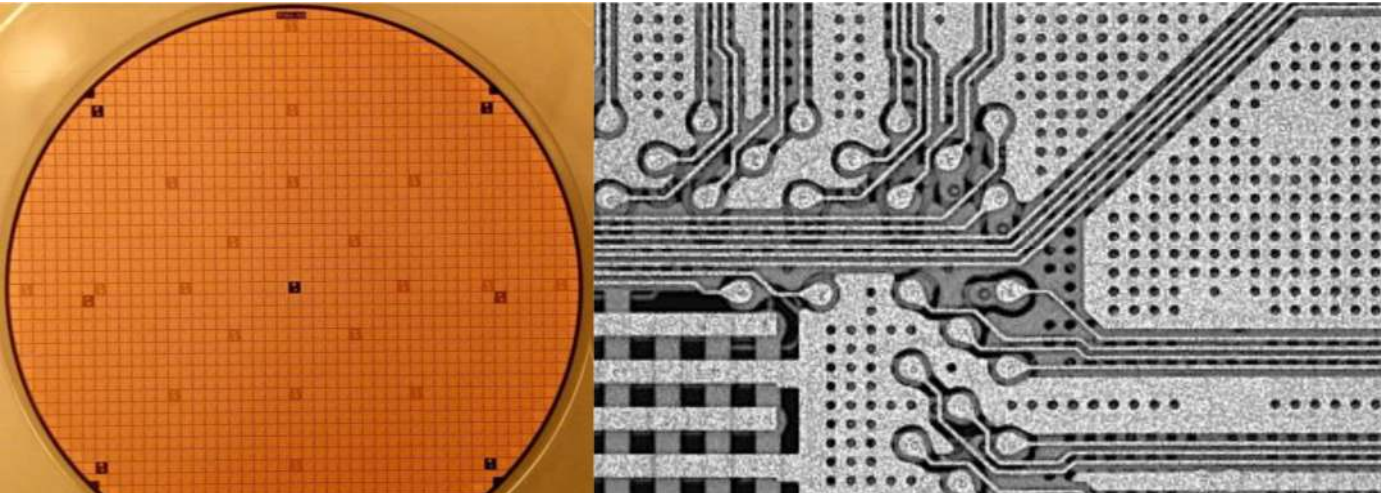


## Step 2: Build unique research capabilities



## Step 2: Build unique research capabilities

- **Deca M-Series Gen 2** fan-out wafer-level packaging and **Adaptive Patterning**
- **300mm** round “panels”
- SHIELD USA: **organic substrates**



## Step 3: Use models that allow all innovators to access those capabilities

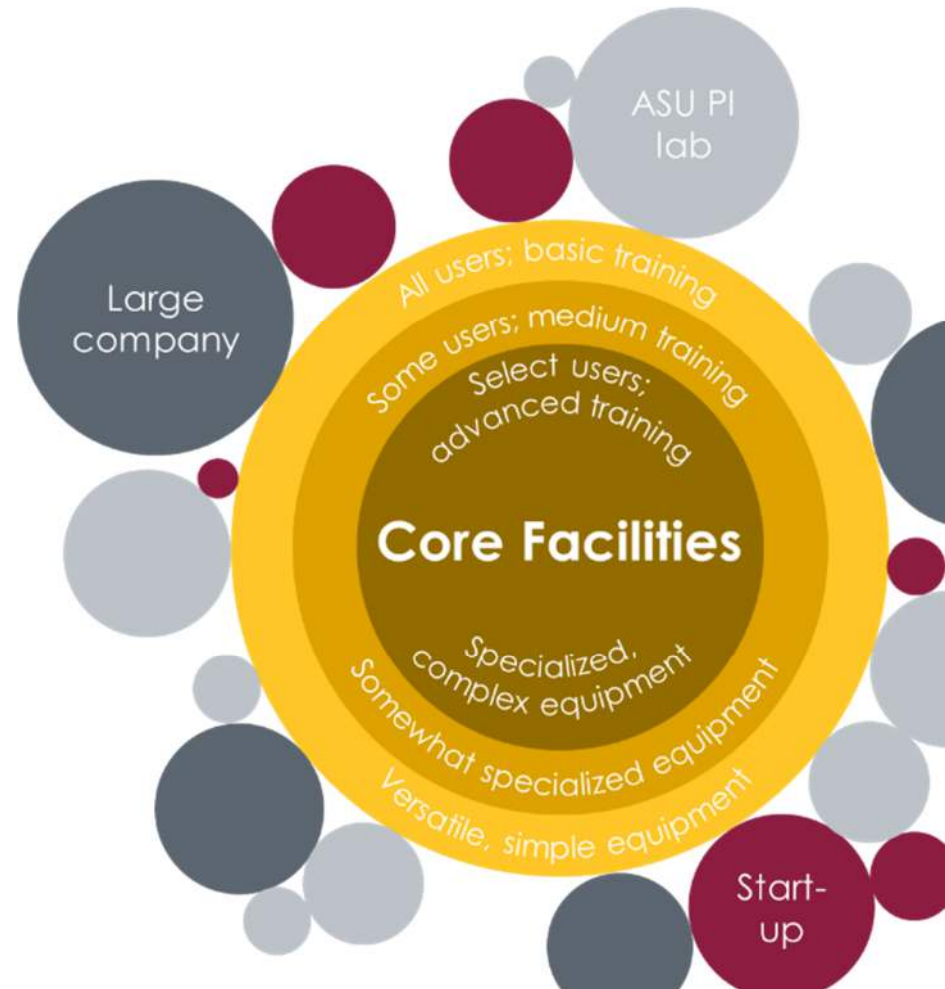
Strong core facilities (available to all) for democratized research

Small “proprietary” faculty and industry labs

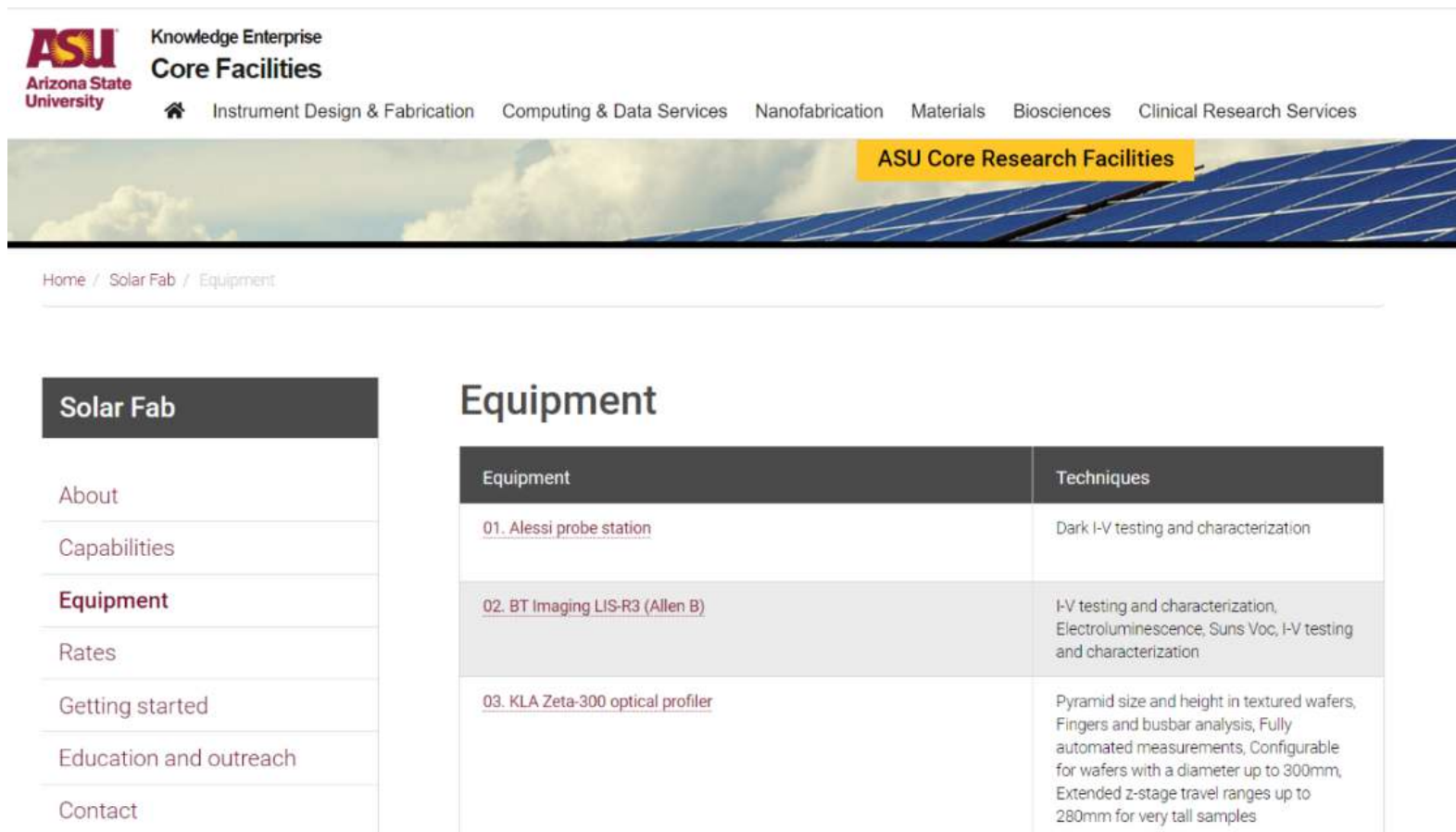
Key corporate partners enhance capabilities and engage in joint research

Lease + user fees + research collaboration model

Undergraduate, graduate, and employee training



# Step 3: Use models that allow all innovators to access those capabilities



The screenshot shows the ASU Core Facilities website. The header includes the ASU logo and navigation links for Instrument Design & Fabrication, Computing & Data Services, Nanofabrication, Materials, Biosciences, and Clinical Research Services. A banner image of solar panels is overlaid with the text "ASU Core Research Facilities". The breadcrumb trail reads "Home / Solar Fab / Equipment". A left sidebar menu lists "Solar Fab", "About", "Capabilities", "Equipment" (highlighted), "Rates", "Getting started", "Education and outreach", and "Contact". The main content area is titled "Equipment" and contains a table with three rows of equipment and their associated techniques.

ASU Knowledge Enterprise  
Arizona State University  
Core Facilities

Instrument Design & Fabrication Computing & Data Services Nanofabrication Materials Biosciences Clinical Research Services

ASU Core Research Facilities

Home / Solar Fab / Equipment

**Solar Fab**

- About
- Capabilities
- Equipment**
- Rates
- Getting started
- Education and outreach
- Contact

## Equipment

| Equipment   | Techniques   |
|---|--|
| <a href="#">01. Alessi probe station</a>          | Dark I-V testing and characterization  |
| <a href="#">02. BT Imaging LIS-R3 (Allen B)</a>   | I-V testing and characterization, Electroluminescence, Suns Voc, I-V testing and characterization  |
| <a href="#">03. KLA Zeta-300 optical profiler</a> | Pyramid size and height in textured wafers, Fingers and busbar analysis, Fully automated measurements, Configurable for wafers with a diameter up to 300mm, Extended z-stage travel ranges up to 280mm for very tall samples |

# Step 4: Enable—and incentivize—industry partnerships and entrepreneurship

## Fulton Partnerships In Engineering Research (PIER) Spring 2026 Funding Opportunity Announcement (FOA)

|  |                          |
|--|--------------------------|
| FOA issue date                           | April 20, 2026           |
| Proposal submission deadline             | May 25, 2026 at 5 pm MST |
| Expected selection notification date     | June 25, 2026            |
| Contract negotiations and projects begin | July and August, 2026    |

<https://asu.infoready4.com/#freeformCompetitionDetail/2013811>

Please direct questions to [s.jones@asu.edu](mailto:s.jones@asu.edu).

### 1. Funding opportunity description

#### a. Opportunity overview

With this FOA, FSE is soliciting proposals for PIER research and development projects that are collaborations between ASU researchers and industry partners or other stakeholders. Successful proposals will have co-investment from the stakeholder partner such that a portion of the project costs expended at ASU will be funded by FSE through PIER and a portion will be funded by the partner, as detailed below. Projects must be 12 months in duration and have a direct-cost budget of \$80,000. It is anticipated that approximately five awards will be made in response to this FOA.

# Step 4: Enable—and incentivize—industry partnerships and entrepreneurship

## b. Topics of interest

Applicants may submit proposals on any topic that advances engineering research. However, proposals are encouraged to align with active FSE research priorities and to build bridges to larger collaborative funding opportunities, per the review criteria below. Present FSE research priorities include:

- *Microelectronics*, including RF and power devices; advanced packaging; 2D and other new semiconductor materials; test; quantum algorithms; fab manufacturing processes; data center planning, operation, and efficiency; and fab construction, operation, and maintenance
- *Medicine*, including cell and tissue engineering; AI and digital tools; imaging; biosensors; medical devices; and bioelectronics and lab-on-a-chip devices
- *Space, defense, and national security*, including autonomous systems; robotics; advanced manufacturing techniques; communications; defense systems; spacecraft; energy generation, transmission, and storage; and critical mineral extraction, processing, and recycling

# Step 4: Enable—and incentivize—industry partnerships and entrepreneurship

## About the Fulton FIRE Fellowship

FIRE fellowships are designed to support late-stage PhD students, postdoctoral scholars, faculty and staff building ventures to commercialize their technology.



### Who is eligible for the FIRE Fellowship?

The FIRE Fellowship is designed for emerging and research-focused scholars ready to lead bold, high-impact work.

#### You may apply if you:

- Hold a PhD in engineering or a closely related field.
- Will complete your PhD before the fellowship start date.



### Receive up to 24 months of funding and venture support

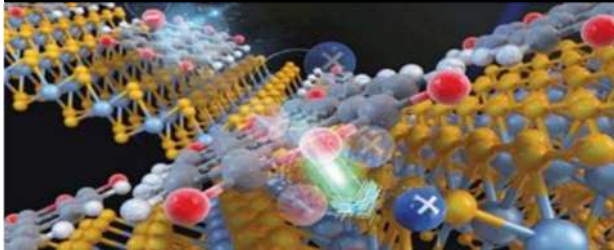
Fulton FIRE Fellowships support founders building ventures to commercialize ASU deep technology. Fellowships are up to 24 months and include:

- Full-time salary and benefits
- Credits for ASU Core Facilities and other university resources
- Dedicated workspace at an ASU tech-commercialization site

# These steps underpin recent industry partnerships

## Semiconductor Materials

**\$270M partnership with Arizona Commerce Authority and Applied Materials to create cutting-edge Materials to Fabrication lab at MTW**



## Advanced Packaging & Heterogenous Integration

**DoD Microelectronics Commons investment for Deca 300 mm Fan Out Wafer Level capability at ASU with license to run M-Series and Adaptive Patterning at MTW**



## Power Electronics and 5G/6G

**\$17.5 million partnership with Arizona Commerce Authority and NXP to create high-frequency and high-power device test capabilities at MTW**



# And the success of ASU startups

PHOENIX BUSINESS JOURNAL ACCESS ALL ARTICLES SUBSCRIBE NOW

Technology  
**ASU spinoff Advent Diamond using research to commercialize diamond electronics**

PHOENIX BUSINESS JOURNAL OFFER ENDS SOON SAVE OVER 50%

Technology  
**ASU professor, startup co-founder receives funding award for nanotech invention**

Company's tool can coat everything from silicon wafers to pieces of clothing to aluminum foil

Technology  
**Phoenix-based Crystal Sonic takes home first place in global pitch competition**

Facebook LinkedIn X Print Email



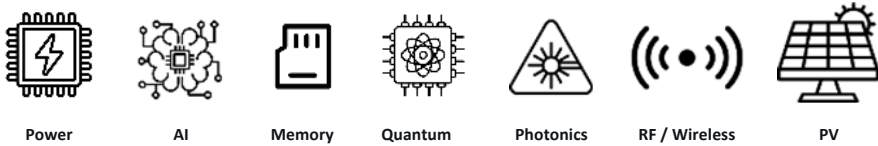


## Executive Summary

Revolutionizing chip manufacturing with the power of **sound**.

### The Problem:

- Legacy chip manufacturing is **wasteful** and **costly**.
- Tomorrow's chips rely on **advanced wafer materials** for:



### Our Technology: **Sonic Lift-off**

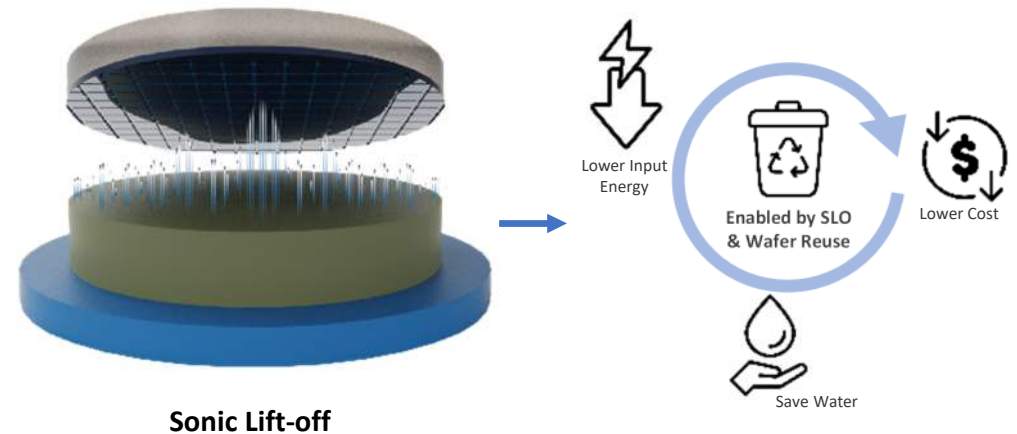
- We harness **acoustic energy** to split wafers to **reduce waste, lower cost** and **enable new technologies** in semiconductor manufacturing.
- **Sonic Lift-off** enables **wafer re-use**, previously unachievable with legacy approaches.
- **Patented** in the US, Asia and Europe. 10 patents.

### The Opportunity

- Sonic Lift-off enables:
  - Chip manufacturers to **lower cost** and advance **new technologies**.
  - Critical material **supply-chain resilience**.
  - Manufacturing **sustainability**.
- Wafer types: **SiC, GaN, GaAs, TFLN, AlN, Si** and more.

### About Crystal Sonic

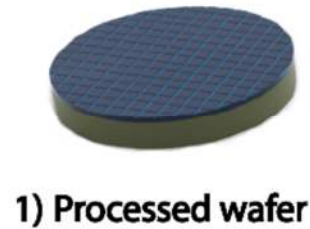
- Award winning **deep-tech start up** based in **Phoenix, AZ**
- Advanced semiconductor manufacturing process technology
- 10 employees
- **\$6.2M raised** via pre-seed, venture and awards from DOE, NASA, NSF, DARPA & PEI.
- Winners of 2024 [Lam Capital Venture Competition](#), [NSTC Pitch](#), and [S3 Finalists](#).



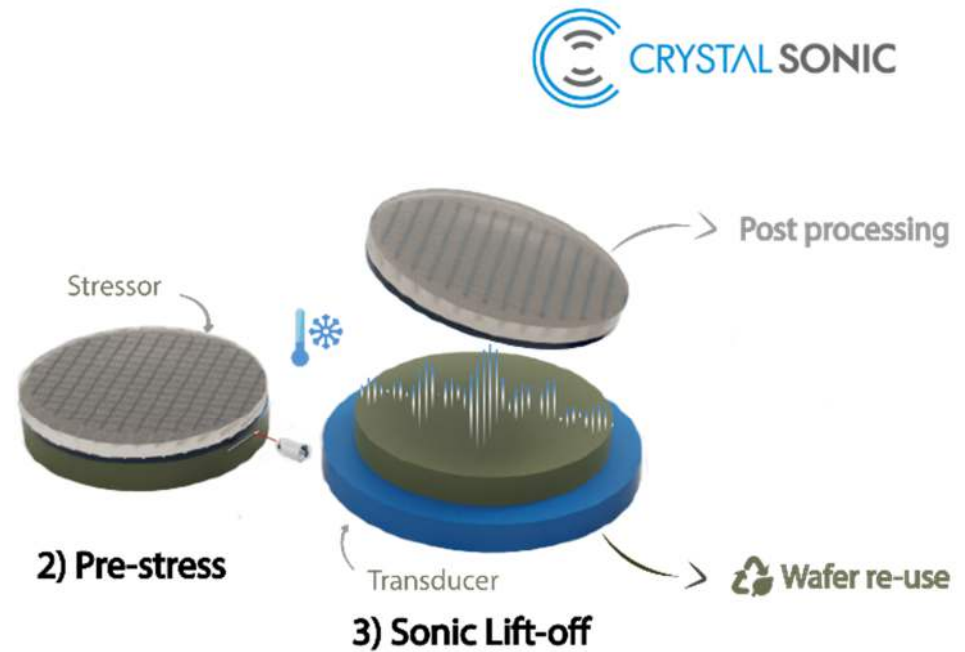
# Sonic Lift-off

*Device lift-off use case (wide band-gap and high-value substrates)*

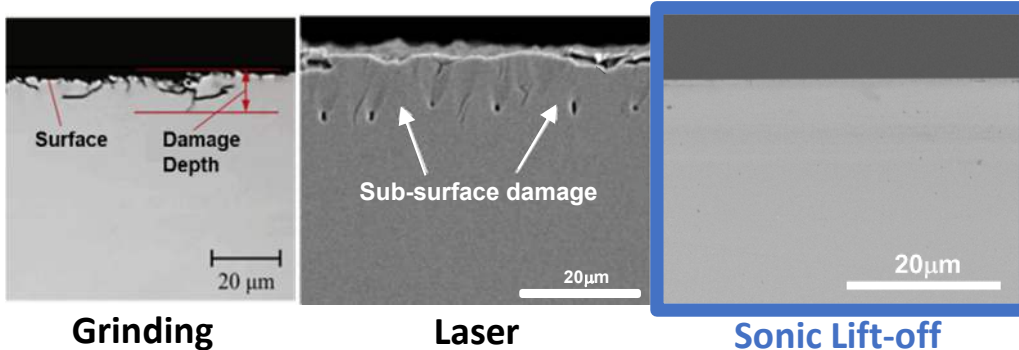
**Sonic Lift-off (SLO)** enables **substrate re-use** by employing acoustic energy to release devices from wafers, **replacing backgrinding** and other wasteful steps in chip manufacturing.



1) Processed wafer



**Pristine sub-surface quality:** unlike alternatives.



←

- No sub-surface damage
- Device lift-off + wafer re-use
- High throughput & scalable.
- Broad applicability: SiC, GaN, Si, GaAs, TFLN, etc.

# Space PV Applications of Sonic Lift-off



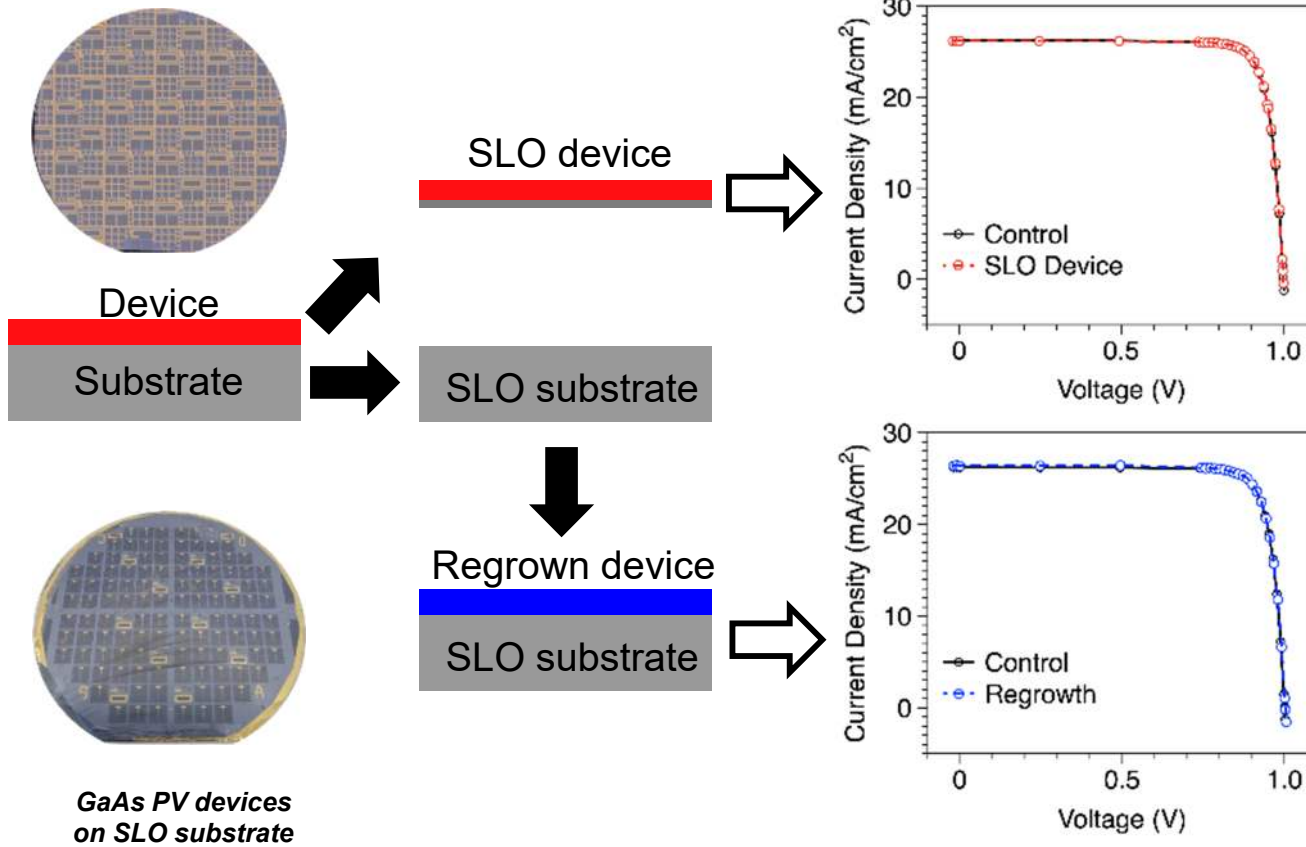
**2023-2026: NASA SBIR Ignite** – Phase I, II and II-E support for \$1.4M to develop sonic lift-off for space photovoltaics.

**2020-24: DOE SETO** Sub-award for PV reuse



# PV Device Lift-off & Substrate Reuse

✓ No losses on GaAs PV devices after SLO and substrate reuse



|            | $J_{sc}$<br>(mA/cm <sup>2</sup> ) | $V_{oc}$<br>(V) | FF<br>(%) | Efficiency<br>(%) |
|------------|-----------------------------------|-----------------|-----------|-------------------|
| Control    | 26.13                             | 1.0             | 84.0      | 22.0              |
| SLO Device | 26.12                             | 1.0             | 84.2      | 22.0              |
| Regrowth   | 26.3                              | 1.0             | 83.8      | 22.0              |

Supported by DOE/SETO grant in collaboration with ASU, NREL and RIT under contract number # DE-EE0008973.

## Advent Diamond Breaks the SWaP-C and Performance Barrier for RF and Quantum Applications

### Radar and Telecommunication

RF and High-Power Components

**2–3×**

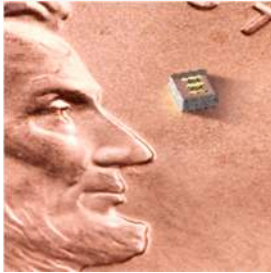
Thermal budget  
vs. SOTA

**>40%**

Longevity &  
power output

**>50%**

System size  
& weight



*Miniaturized diamond RF receiver protector die (shown here on a penny for scale) validated for >100 W*

We solve this pain point by giving engineers a higher "thermal budget" **2–3× SOTA** and "higher Frequency" **GHz-THz**.

#### Diode Limiter (Lead Product):

Proven prototype performance by Defense Contractor for >100 Watts operations which is higher than the SOTA products

### Quantum Sensing

Solid-state Readout Platform

**>50%**

Quantum Sensor  
size reduction

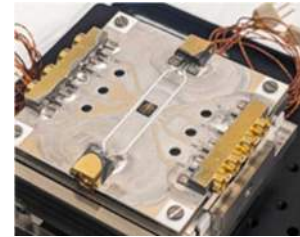
**LASER FREE**

All-electric control &  
readout

**100%**

**Solid-State**

Eliminate or reduce the  
need of cryogenics



*First in class electric-readout quantum sensors*

We provide a proprietary diamond solution that transforms quantum sensing enhanced quantum state stability in engineered diamond

#### Quantum Magnetometer (Lead Product):

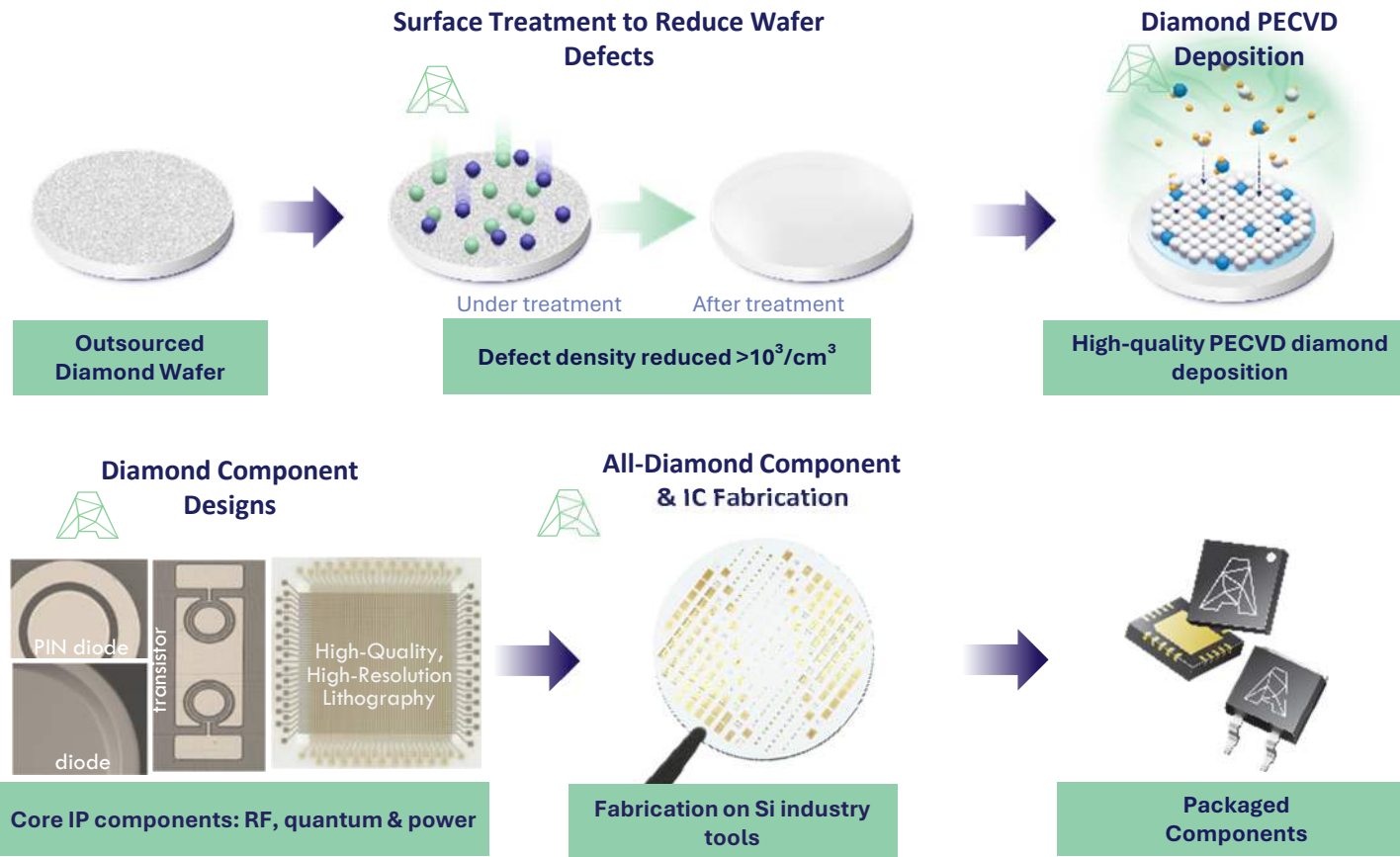
Proven prototype performance under NASA SBIR – 20x higher signal using electrical readout. Collaboration with FEI Electronics.

*One proprietary diamond platform — two breakthrough applications — serving defense, telecommunications, and commercial markets.*

# Our Platform Technology



## Semiconductor Technology Beyond Today's Limits



### IP MOAT & KEY DIFFERENTIATORS

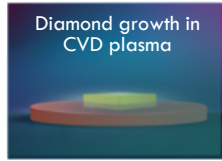
- Proprietary controlled doped diamond film manufacturing
- Lowest contact resistance ever reported for diamond Ohmic contacts
- Defect reduction process  $>10^3/\text{cm}^3$  improvement
- Standard Si fab tools — no exotic capex
- Core IP & Design Ownership covers RF, quantum & power applications
- Validated supply chain for scaleup and commercialization

End-to-end platform control — from raw diamond to packaged component — built on standard silicon industry tools for scalable, low-cost production.

# Company History



**Key patent filed** for phosphorus-doped diamond process



2016

The **first** all-diamond IC: a receiver protect component for RF Front Ends

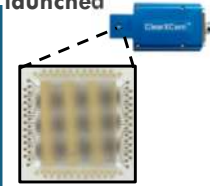


2023

**Industrial-scale fab** for product development in partnership with ASU

2024

**First product** of Diamond Radiation Sensor **launched**



2024

Case studies with key partners using all-diamond diodes

2025

## Technology Development

## Commercialization

2004 - 2006

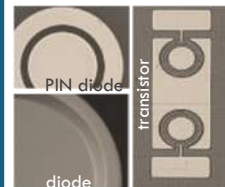
Prof. Nemanich initiated the 1st US semiconducting diamond research program

2018



**Established** with NSF funding

2019 - 2023



Prototypes of Schottky diodes and PIN diodes developed

2023

**Collaborations with Fortune 500 Prime Defense Contractors**



2024



Secured **DARPA funding** for scaling diamond technology (LADDIS and UWBGs programs)

**Over \$17M** funded to date from various sources, including DoE, DoD, and NASA



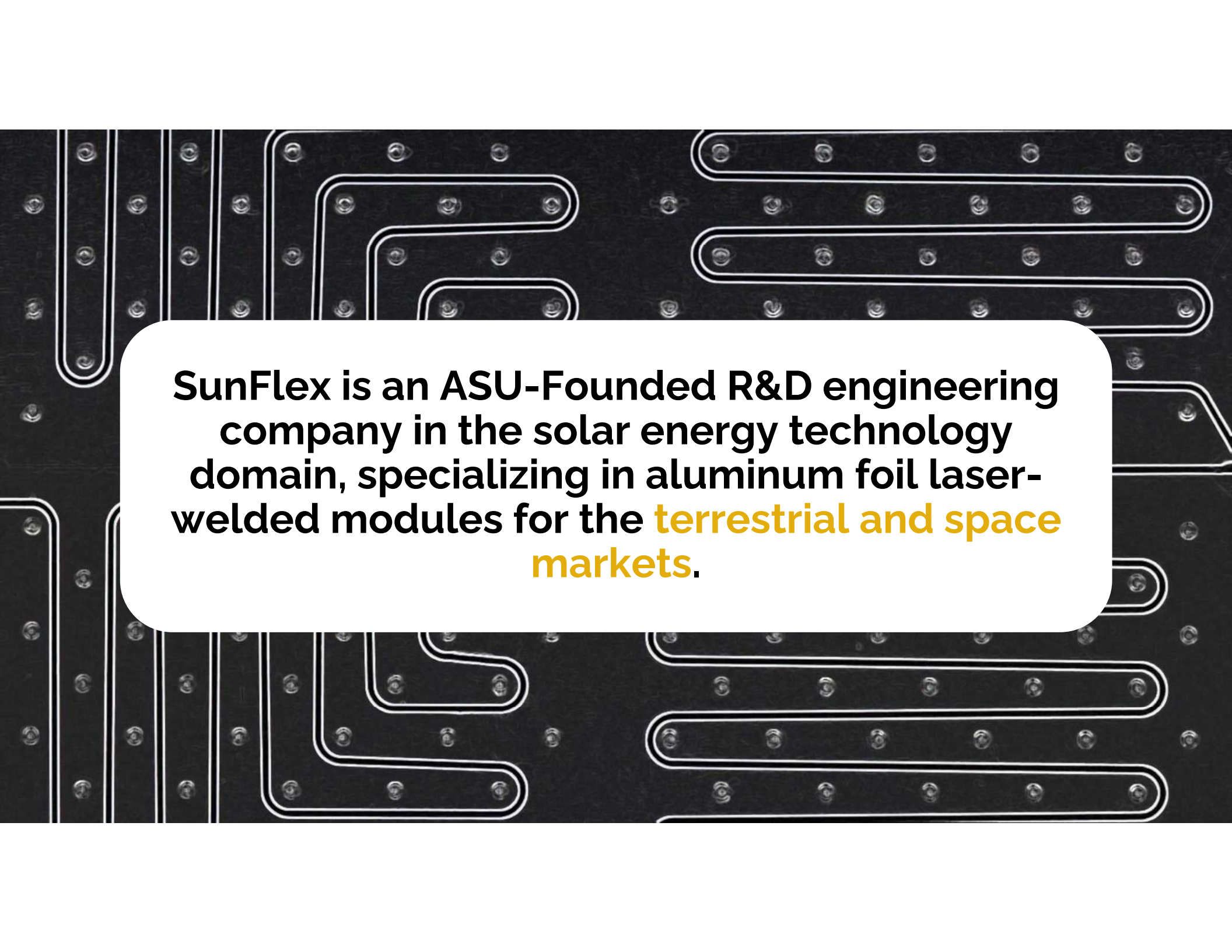
2026

**Commercialization and scaleup**



SUNFLEX

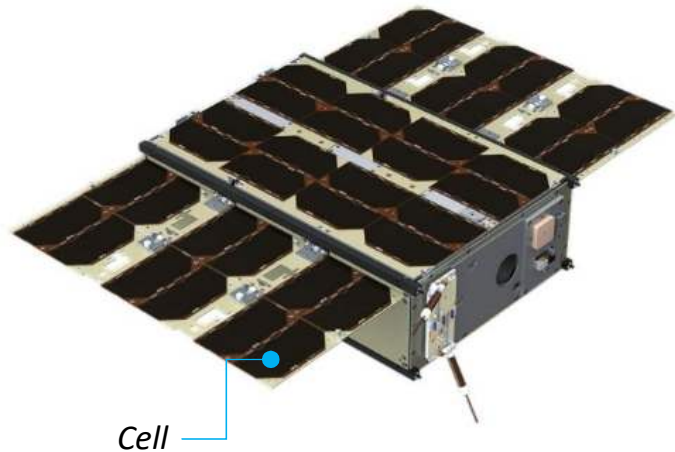
LASER-WELDED INTERCONNECTION OF BACK-CONTACT CELLS



**SunFlex is an ASU-Founded R&D engineering company in the solar energy technology domain, specializing in aluminum foil laser-welded modules for the **terrestrial and space markets.****

# Satellites: Every Module is a Snowflake

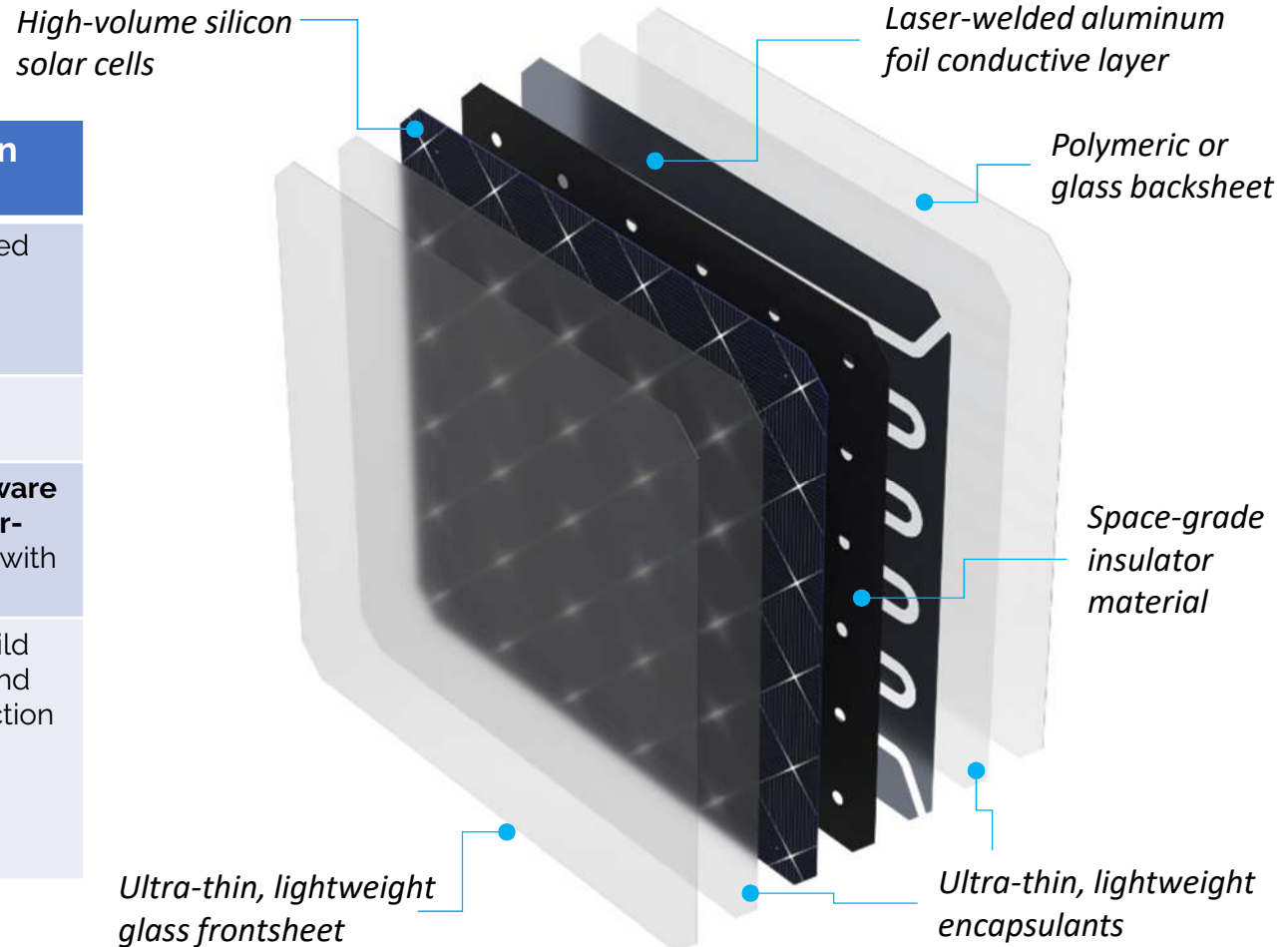
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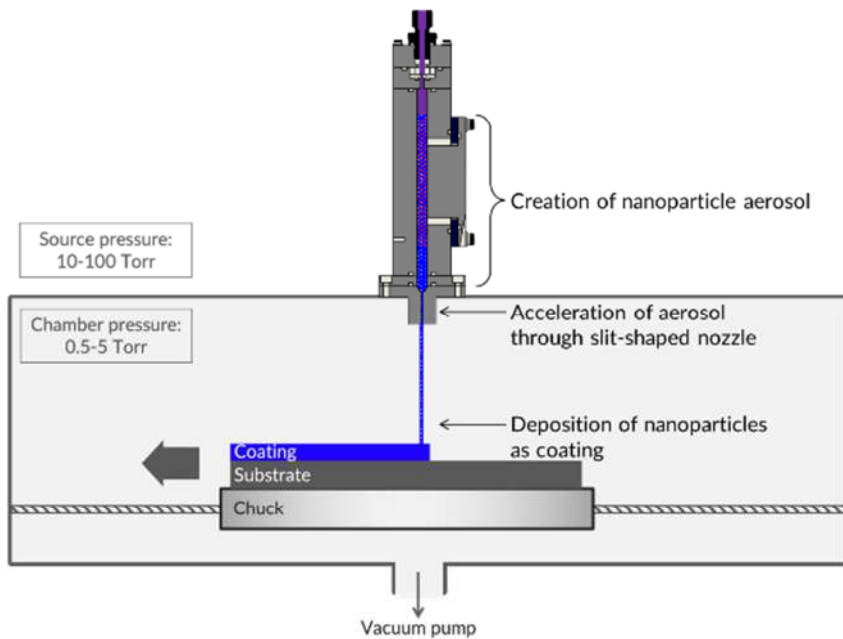
- Almost every satellite panel and array **is a unique design**
- Cells must be patterned in **irregular shapes and locations**, in order to make the most of available surface area
- The space industry needs a low-friction, highly-automated process for the **rapid design and integration** of satellite solar arrays, using **readily-available** materials with robust supply chains.

# Solution: SunFlex AetherFoil Solar Modules

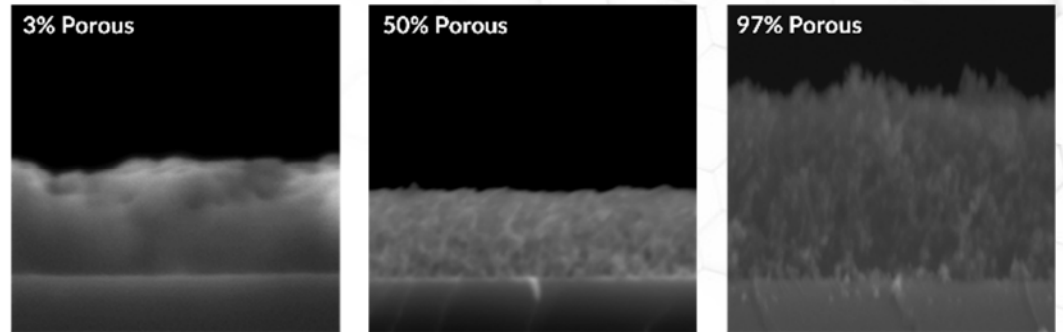
| Conventional Solution   | AetherFoil Solution   |
|---|---|
| Modules made with III-V GaAs cells, total global supply < <b>10MW</b> | Uses silicon cells developed for the terrestrial market, global supply 1TW+ ( <b>1,000,000+ MW</b> )                          |
| Modules that cost <b>\$50-\$200/W</b>                                 | Priced less than <b>\$10/W</b>  |
| Patterning done <b>manually</b> and <b>cells placed by hand</b>       | Patterning done with <b>software automation</b> and cells <b>laser-welded</b> to conductive foil with automated manufacturing |
| Labor-intensive design and build process, with high-friction changes. | Automated design and build process, changes to cell and module layout are low-friction  |
| <b>Low Volume, Low Mix</b>  | <b>High Volume, High Mix</b>  |



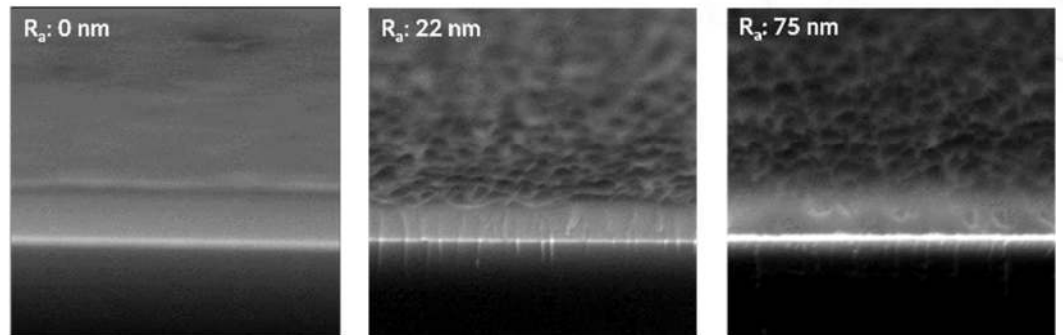
# SWIFT COAT



## Porosity Control



## Surface Roughness Control



Aerosol Impact-Drive Assembly (**AIDA**) is an inline method to deposit thin films composed of nanomaterials with tunable **porosity** and **surface roughness**.

# SWIFT COAT

The image shows a large, black industrial machine with a control panel on the left side. The control panel features a monitor displaying a software interface, a keyboard, and a mouse. The main body of the machine is black with the words 'SWIFT COAT' printed in white on the front. On top of the machine, there are various mechanical components, including pipes, valves, and a green light. The machine is mounted on wheels and has a complex network of cables and hoses connected to it.

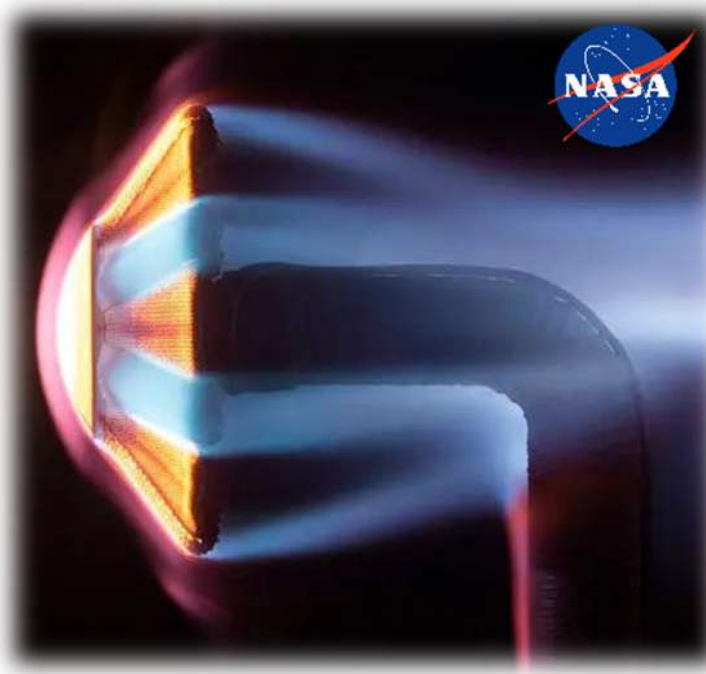
Swift Coat's sheet-to-sheet AIDA tools presently coat up to 1 m x 0.5 m (2 m x 1 m soon)

# SWIFT COAT

## AIDA Coatings for Space Applications



Durable Anti-Reflective and Anti-Fog Coatings



ATOX-Resistant Coatings for Carbon Fiber Materials used in ADEPT Platform

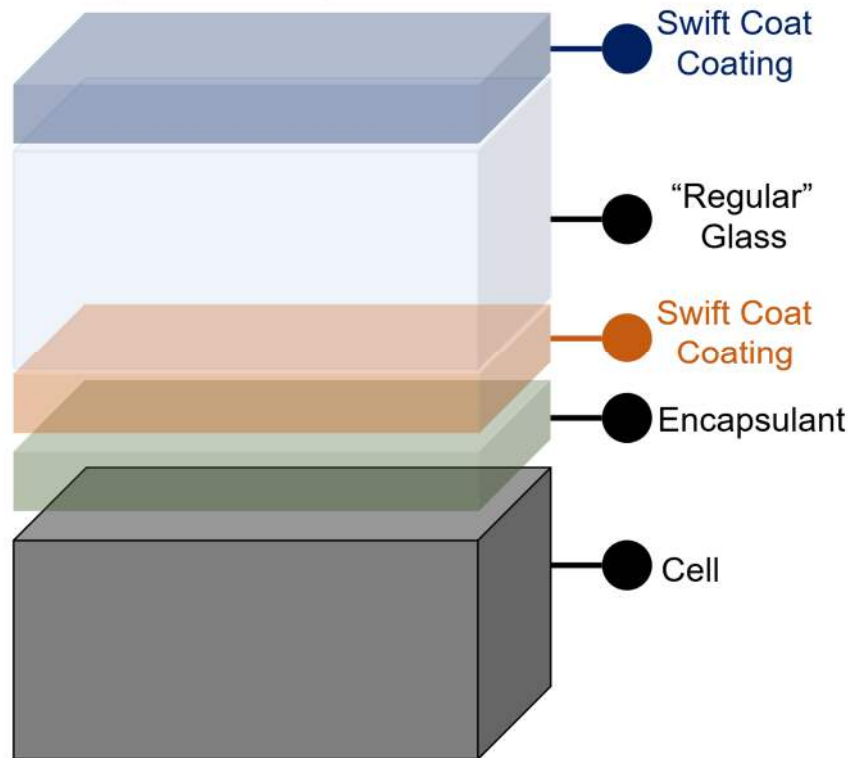


Anti-Reflective Coatings for Space-PV Systems

# SWIFT COAT

**Up next:** Inexpensive, higher-performing, alternative to legacy space-qualified glass

## Space Adapted Glass



**3% Higher transmittance**  
Compared to Uncoated Glass

**UV Filtering**  
30% Reflected  
70% Absorbed

**ESD**  
1000  $\Omega$ /  Sheet Resistance

# Zeolite Separator Platform Technology

## for Fire-Safe and High Energy Density Lithium Batteries

*Prof. Jerry Lin – ASU Membrane and Energy Laboratory and Safe-Li LLC*

### Current Challenges in Lithium Batteries for Energy Storage

#### Lithium-ion Batteries (LIBs):

- Fire hazards due to flammable organic electrolytes and separators
- Limited operating temperature range
- Poor performance when using fire-resistant electrolytes with organic separators, caused by inadequate separator–electrolyte wettability

#### High-Energy-Density Lithium Metal Batteries (LMBs):

- Lithium dendrite formation and penetration, leading to battery failure
- Poor electrode–electrolyte interface, resulting in reduced performance

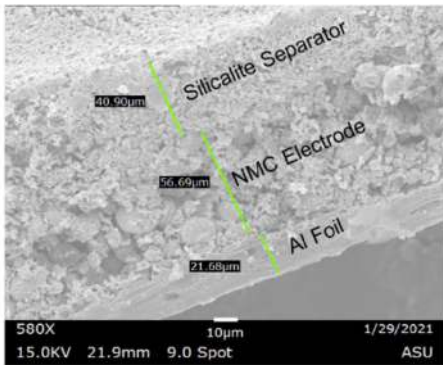
Lin Lab's **Zeolite Separator Platform Technology** addresses all of these challenges.

#### Three US Patents:

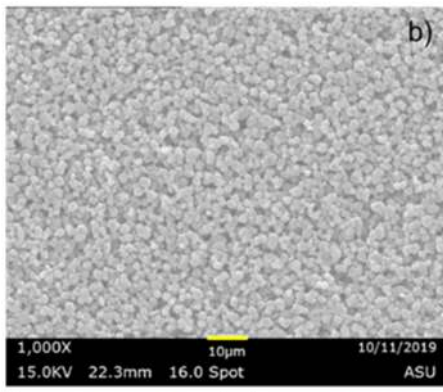
- Jerry Lin, K. Rafiz, “Fire-Proof Lithium-Ion Battery”, *US Patent App*: US 2023/0238644A1, Pub. Date: Jul. 27, 2023
- Jerry Lin, K. Rafiz, “Fast charging quasi-solid state Li-metal batteries enabled by gamma-alumina separators”, *US Patent App.*: US 2024/0250383A1, Pub. Date: Jul. 25, 2024
- Jerry Lin, K. Rafiz, “Plate-structured electrode-coated zeolite separators for lithium-metal batteries”, *PCT Patent App. No.* US 2022/072403, 2022, *US Patent App.*: [US 2024/0283090A1](#), Pub. Date: Aug. 22, 2024

# Lithium-Ion Battery with Zeolite (Silicalite) Separator

Cross-section of NMC cathode coated with a zeolite (silicalite) separator



Surface of zeolite separator



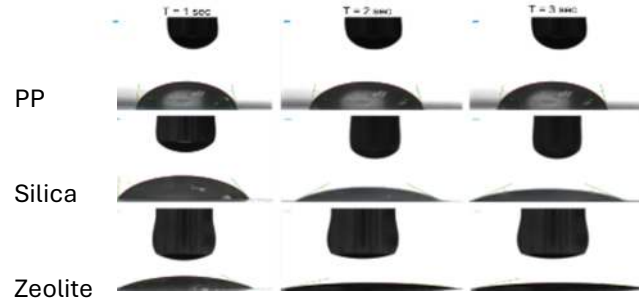
Assembled with graphite anode and filled with fire-proof liquid electrolyte

**Fire-Proof Electrolyte:**  
Lithium bis(fluorosulfonyl)imide (LiFSi)  
in Trimethyl phosphate (TMP)

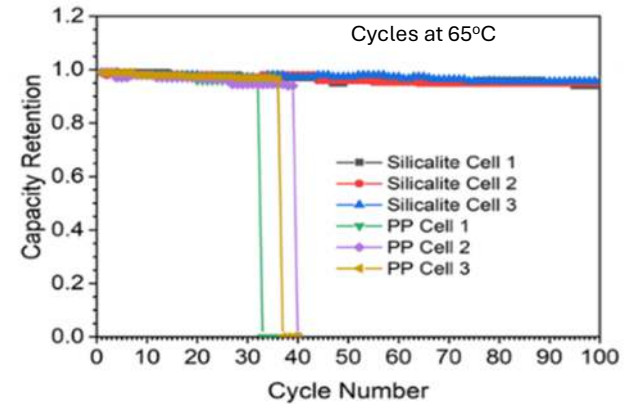
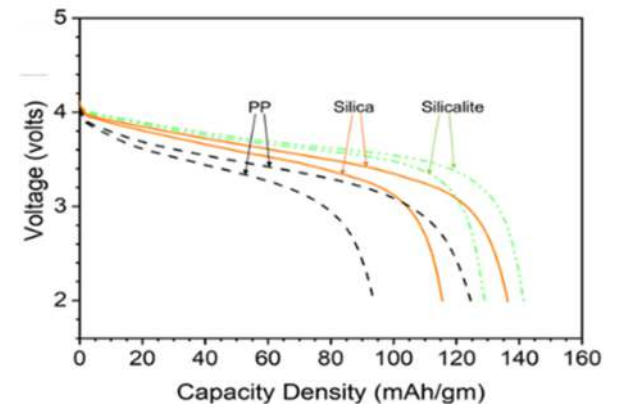


Zeolite wets well with the fire-proof electrolyte

**Dynamic conduct angle of 5.3 M LiFSi/TMP**

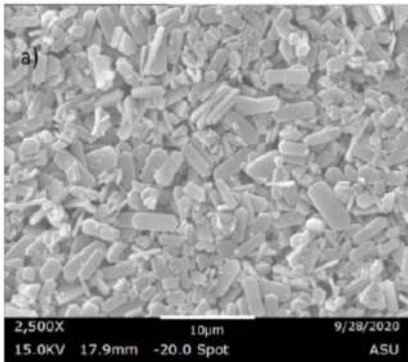


LIBs with fire-proof electrolyte and zeolite separator perform much better than LIBs with PP or silica separators

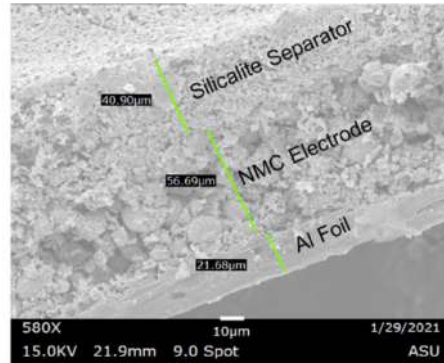


# High Energy Density Lithium Metal Batteries with Plate-Shaped Zeolite Separator

Plate-shaped MFI zeolite

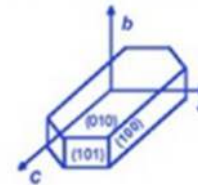


NMC coated Zeolite Separator

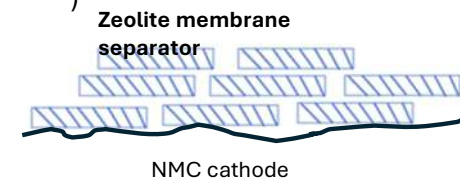


With lithium as the anode, the plate-shaped zeolite separator provides a uniform  $\text{Li}^+$  ion flux and tortuous pore pathways, minimizing dendrite formation and inhibiting dendrite propagation

(a) Plate-Shape MFI Zeolite



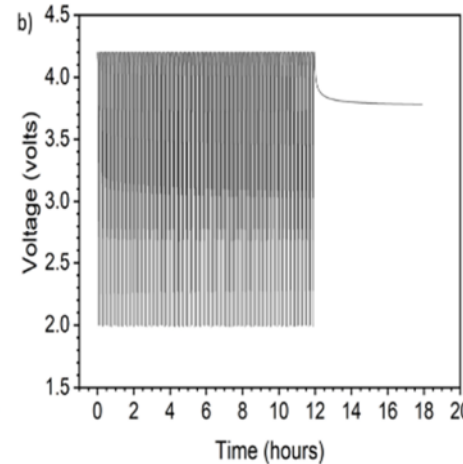
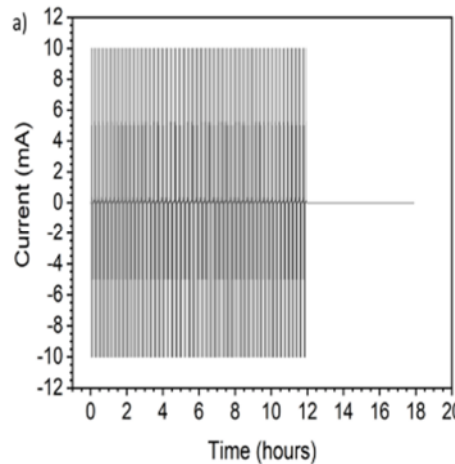
(b)



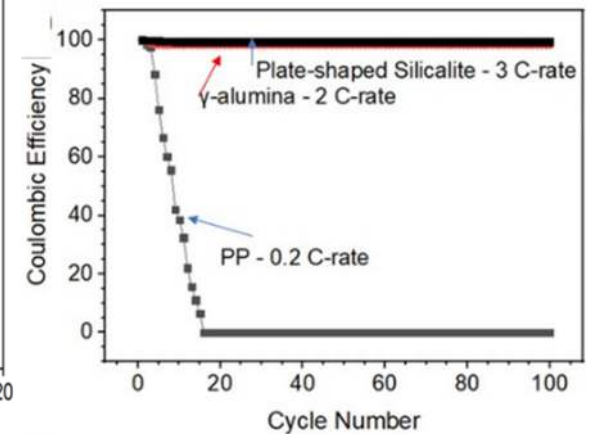
LMB cells:  
NMC/ $\text{LiPF}_6$  - carbonate (1:1:1 EC:DEC:DMC)-zeolite/Li-metal

Performance:  
Long cycles at high current. LMBs with PP separate breaks down due to failure in separator

C and V vs Time at 3C-rate



Coulombic Efficiency

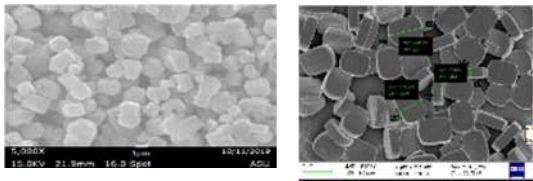


# On-Going R&D Efforts on Zeolite Based Lithium Batteries

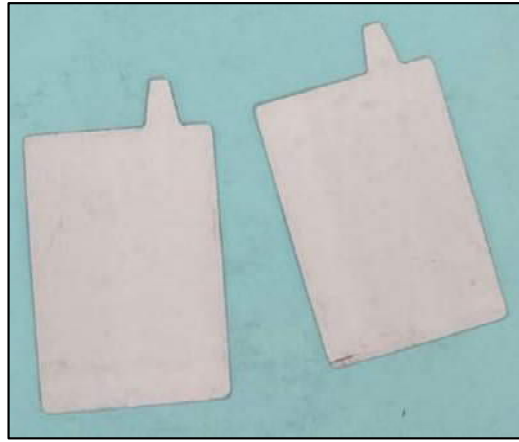
From Lab  
(coin cells  
at ASU)



Scaling up synthesis of  
zeolite powder



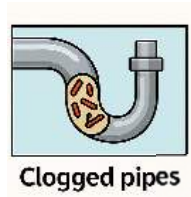
Coating zeolite  
separator on large area  
of cathode or anode



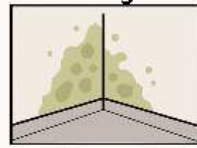
Assembled 1 Ah  
pouch cells



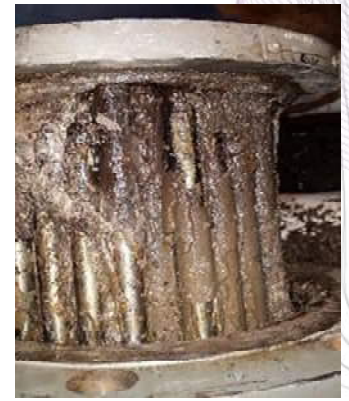
# \$4 TRILLION: Global annual economic adverse impact of **Biofilms**



Clogged pipes



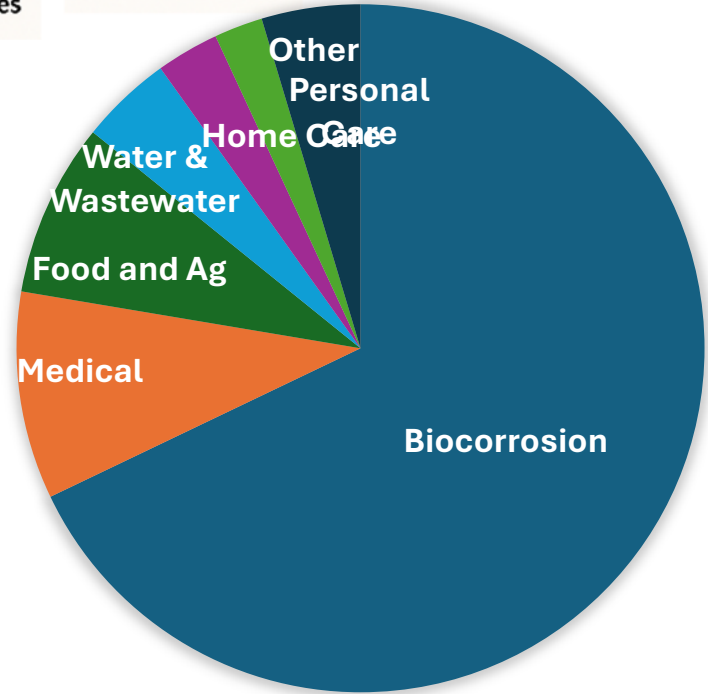
Mold on walls



Legionella from cooling towers

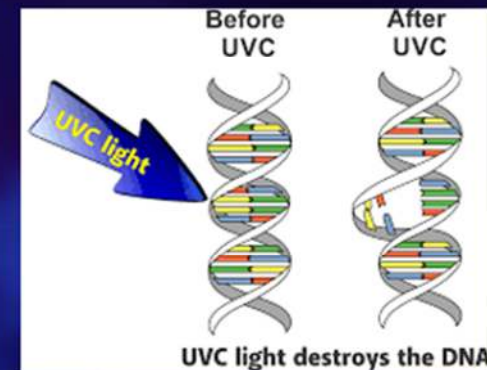


Medical devices

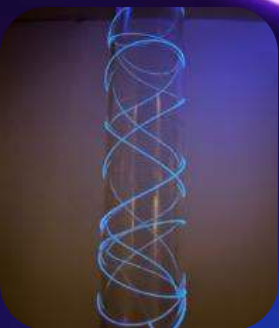




# Our Solution



UV-C-enabled optical fibers for biofilm control



# Evolution of Germicidal Optical Fiber



**Polymicro TECHNOLOGIES**  
A Subsidiary of **molex**



Demonstrate full-scale manufacturability **FSY500600** (> 1 km)



Fibers on ISS as part of NSF-CASIS science (2025-26)

2025-26

2018-2020

2021

2022

2023

2024



aqu<sup>isense</sup> technologies

Gen 1

Gen 2



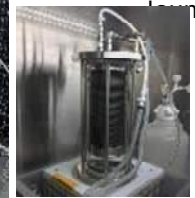
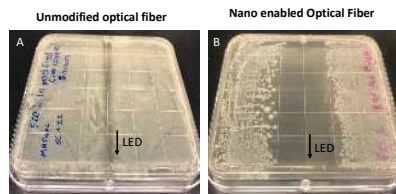
- ASU Westerhoff Lab discloses NP SEOF Coating Method
- Lab NPDip-Coating with Commercial Fiber
- H2Optic Insight started - NASA Phase I Award (2019)

- SEOF-UVC inactivates biofilms
- NASA Phase II Award (2021)**
- Validated Manufacturability of Cypopt-SEOF

- SEOF Design Model 2.0 Validated

- Deliver prototypes to NASA
- NASA Phase II-E Award**

- Commercial Products
- Phase II-E Field
- NASA Phase 3 & NASA Contract**
- Sub-license model launched



# Partner with H<sub>2</sub>Optic Insights

To mitigate biofilm related health, energy and water problems

## Leadership Team



Over \$3M in Undiluted SBIR & Contracts

**Kelly Westerhoff, P.E.**  
President, Managing  
Partner

**Paul Westerhoff, PhD, P.E.**  
Chief Technical Officer

**New CEO**  
Coming soon



## Contacts for follow-ups

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**Sunflex Solar:** Cody Van Cleve, [cody@sunflectech.com](mailto:cody@sunflectech.com)

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**Safe-Li:** Jerry Lin, [jerry.lin@asu.edu](mailto:jerry.lin@asu.edu)

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