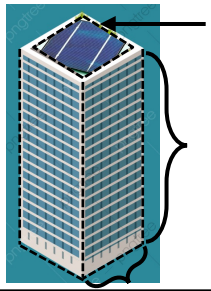
Transparent Solar Concentrator for Building-Integrated Photovoltaics

Nathan Grinalds, Julia Schwieg, Dr. David Wei, Dr. Jiangeng Xue, Stephen Grinalds

"Looking Through to a Cleaner Future"

Motivation

- The United States relied on fossil fuels for 81% of its primary energy production
- Solar technologies provide only 1% of total U.S. energy
- The 2023 U.S. building-integrated photovoltaics (BIPV) market was $24 billion, expected to grow to $90 billion by 2030
- Rooftop solar is necessary but insufficient to meet increasing energy demands while lowering carbon footprint
- Buildings remain underutilized for harvesting solar energy:
- If the Sears Tower (now Willis tower) replaced all its windows with our solar windows, it could generate *~4 GWh of energy per year* (and reduce cooling costs).



Area available for rooftop solar

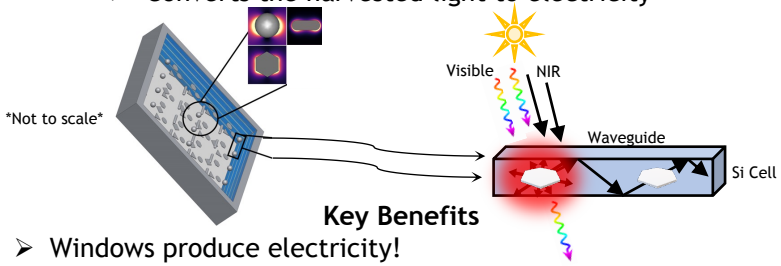
Area available for BIPV solar windows (>10x)

GWh = giga (10^9) Watt hours

How Our Product Works

Three main parts

1. Plasmonic metal nanoparticles (Au)
   - Harvest sunlight via plasmon-enhanced scattering
2. Waveguide (glass)
   - Directs scattered light to the perimeter of window
3. Silicon solar cell
   - Converts the harvested light to electricity



Key Benefits

- Windows produce electricity!
- Blocks ~90% near infrared (NIR) light, reducing cooling costs
- Tunable color and transparency for different aesthetics
- *Reduces the PV material needed* to collect light (cost ↓)

Road Map to Market

- Scale up nanoparticle synthesis procedure to increase solar window fabrication throughput compatible with 1-window per week (4 months)
- Scale up prototype to a 400 cm^2 solar window with PCE >4% and 50% average visible transmittance (TRL 5/6)
- Utilize American Made Connectors, Manufacturers, and National Labs to perform customer discovery, risk mitigation, and obtain product feedback (12 months)
- Reinvest prize money from the Set! and Go! Phases to optimize nanoparticle synthesis, scale up solar window fabrication, and deploy/test field units (3-12 months)
- Automate solar window manufacturing process to increase production and drive down cost (12-36 months)

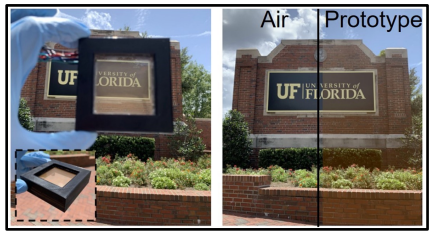
Background

- Scattering solar concentrators (a.k.a "solar windows") are transparent to semitransparent devices used to create electricity from light.
- **Building integrated photovoltaics (BIPV)** convert light to electricity *and replace conventional building materials.*
- Examples: Roof shingles, windows, skylights, and facades.
- Real world BIPVs:

Umwelt Arena - Zurich, Switzerland

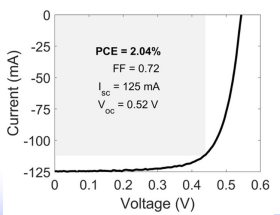
Tesla's Solar Shingles

Prototype Performance

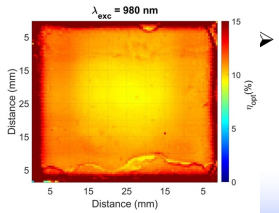


5 x 5 x 1 nm solar window prototype

- ***First ever solar window based entirely on plasmonic metal nanoparticles!***
- 2.04% power conversion efficiency (PCE)
- 57% average visible transmittance
- Efficient waveguiding of NIR light from the unique scattering behavior of our nanoparticles



Photovoltaic figures of merit



2-D optical efficiency map @ 980 nm

Who We Are

- Our team is comprised of PhD students, professors, and entrepreneurs mainly from the University of Florida.
- What began as a research project has evolved into a team striving to bring a novel BIPV to the market
- We share a collective sense of duty and urgency towards building a more **sustainable future**
- To keep up-to-date on our progress, consider following us on LinkedIn