



APPROACH

SMART SOLAR CELLS

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OUTLINE

- The Problem & Opportunity
- The Solution – Research Innovation
- Impact
- Call to Action

The Problem & Opportunity



The Challenge: Solar Efficiency Plateau

Global Challenge: Despite massive solar deployment, commercial PV efficiency remains stagnant at 18-22% for a decade, far below theoretical limits of 33%.

Why It Matters: Every 1% efficiency gain represents:

- 5-7% reduction in solar electricity costs
- 40 million fewer panels needed for 2030 renewable targets
- \$15B+ annual materials/land savings globally

Current Gap: Conventional texturing methods have reached their limits, with diminishing returns from traditional manufacturing approaches.

Our Breakthrough: Femtosecond laser treatment creates precisely engineered nanostructures that dramatically reduce reflection and enhance light capture across the spectrum without compromising cell integrity.



The Solution – Research Innovation

Unique Solution: Our proprietary femtosecond laser patterning creates hierarchical micro/nano textures that optimize light trapping while preserving material integrity.

Advantages Over Existing Approaches:

- Achieves sub-wavelength features impossible with conventional wet etching
- Single-step process eliminates multiple manufacturing stages
- Compatible with existing production lines with minimal retooling
- Works across multiple PV technologies (c-Si, thin-film, perovskites)

Early Results: Laboratory tests demonstrate 2.7% absolute efficiency gains on commercial cells, with microscopy confirming unprecedented 97% light absorption across the solar spectrum.

Impact



Scientific Impact:

- Fundamentally advances light-matter interaction understanding at ultrafast timescales
- Bridges the gap between theoretical efficiency limits and practical manufacturing
- Creates new paradigm for selective material property modification without thermal damage

Industrial Impact:

- Solar manufacturers gain 15-20% increased power output from existing production lines
- Semiconductor industry benefits from transferable high-precision surface engineering techniques
- Reduces silicon material requirements by 10-15% for equivalent power generation

Sustainability Impact:

- Directly supports EU Green Deal 55% emissions reduction target by 2030
- Potential to avoid 120+ million tons of CO₂ annually by 2035 through improved solar deployment
- Reduces critical material consumption in renewable energy infrastructure
- Accelerates grid parity for solar in northern European regions by 2-3 years



Call to Action



Key Partnerships Needed:

- Material scientists for specialized surface characterization and durability testing
- Solar cell manufacturers willing to provide production-line test opportunities
- End-users for field validation under real-world conditions

Why Now Is Critical:

- Our expertise in ultrafast optics bridges a critical gap between photovoltaics and laser processing fields
- Early adopters will secure 12-18 month competitive advantage
- Current technology readiness level (TRL 4) ideal for strategic investment with 18-month commercialization timeline

Additional Requirements:

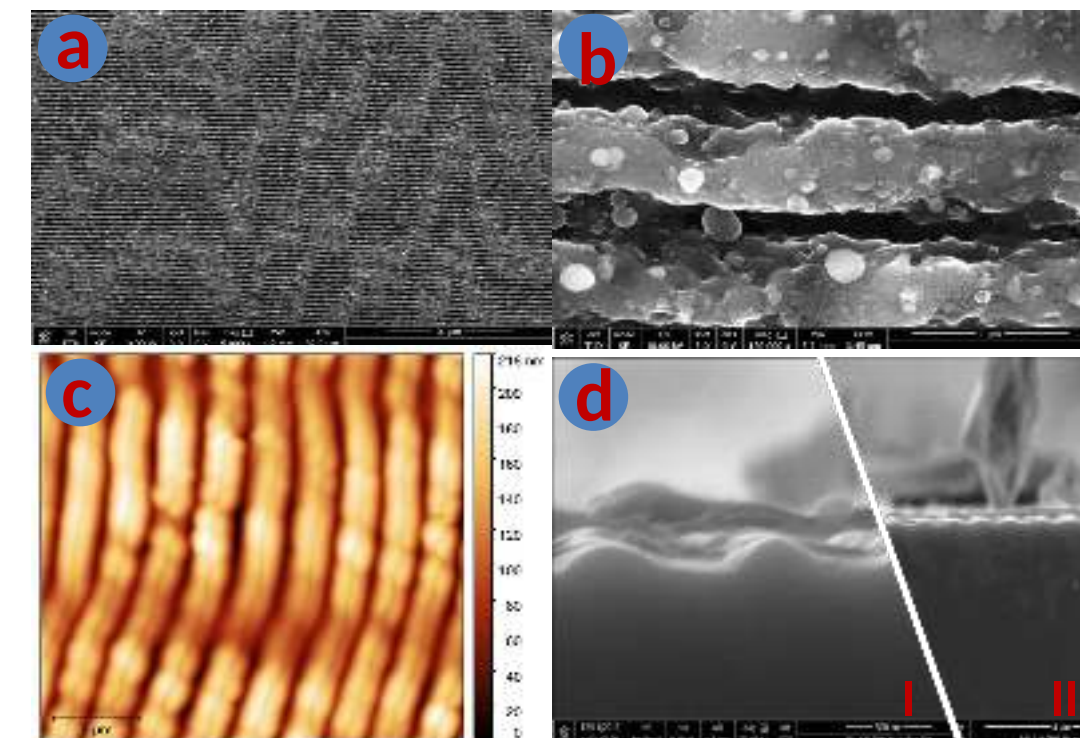
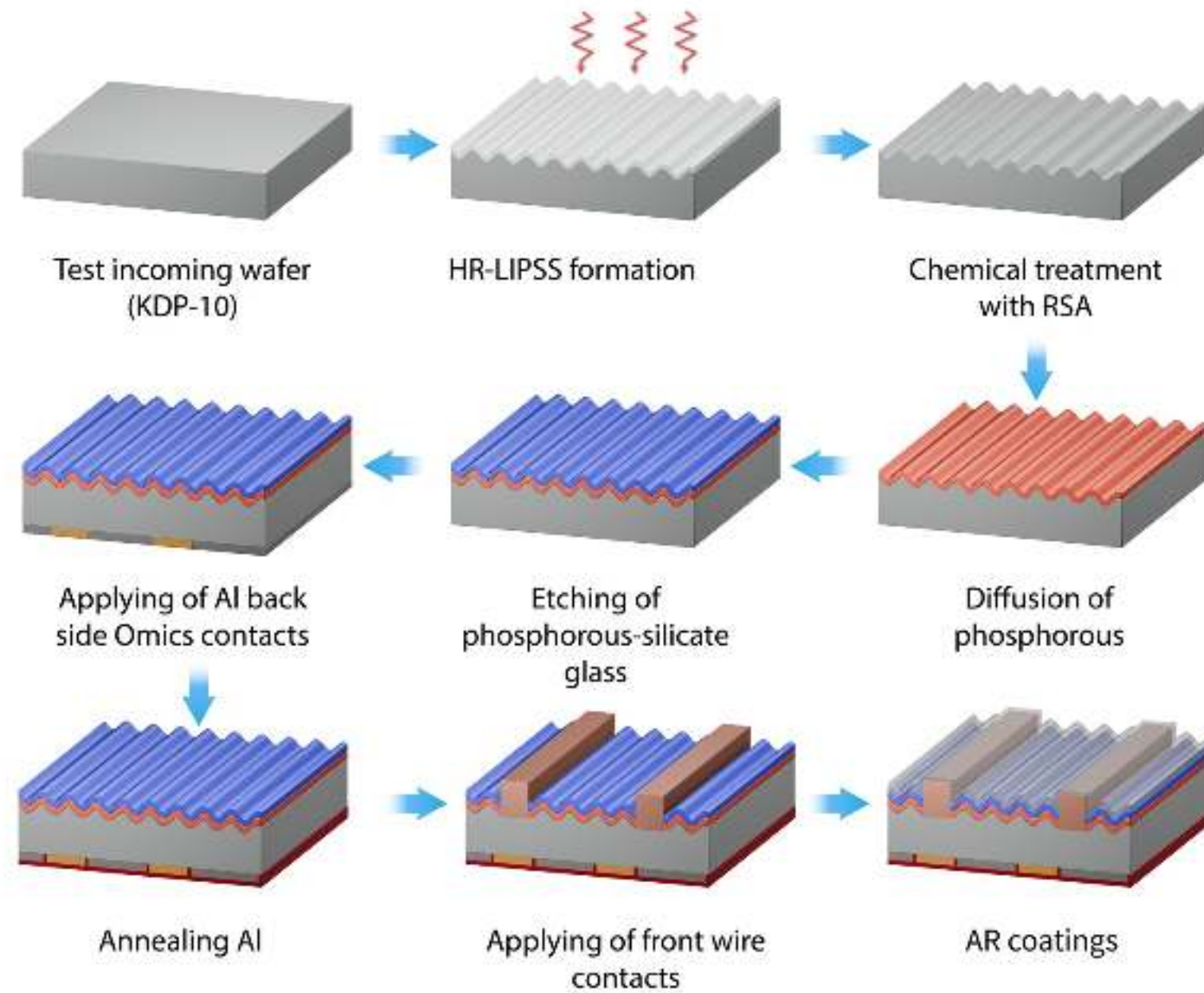
- €2.3M funding for prototype scaling and validation
- Access to specialized characterization facilities for accelerated lifetime testing
- Regulatory support for expedited certification of modified cells
- Technical talent in automation and process control for manufacturing integration



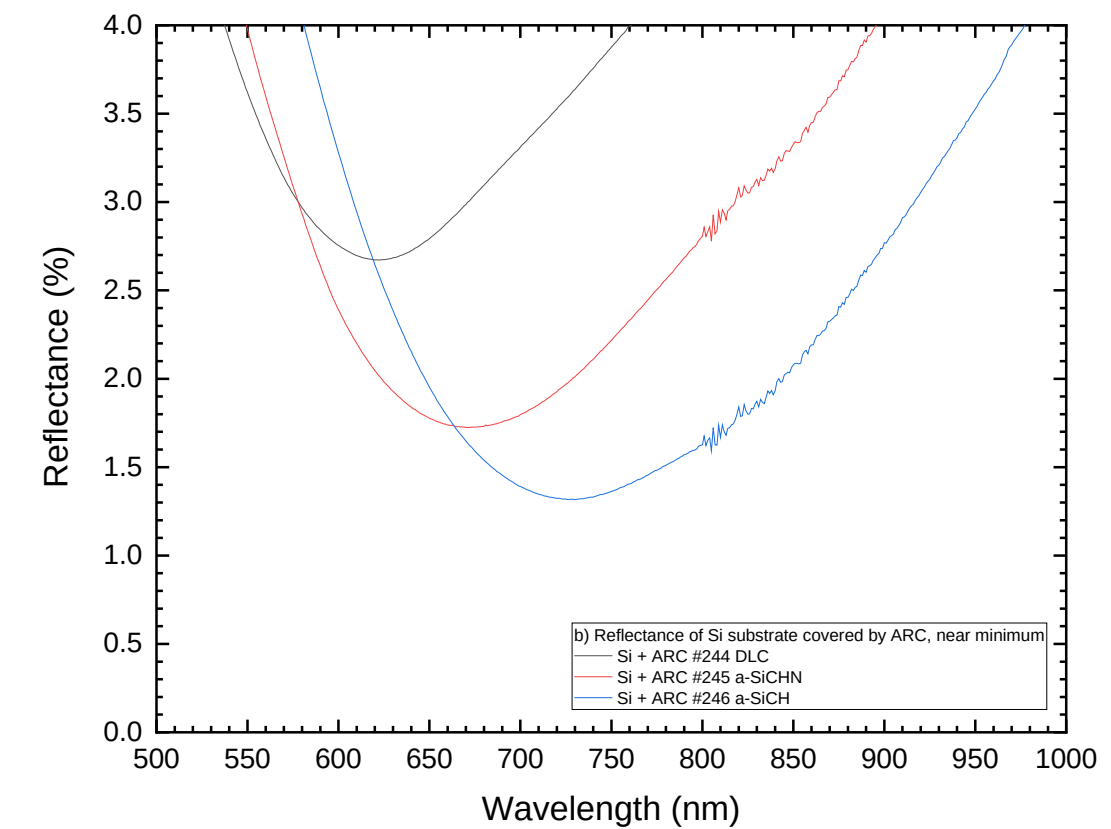
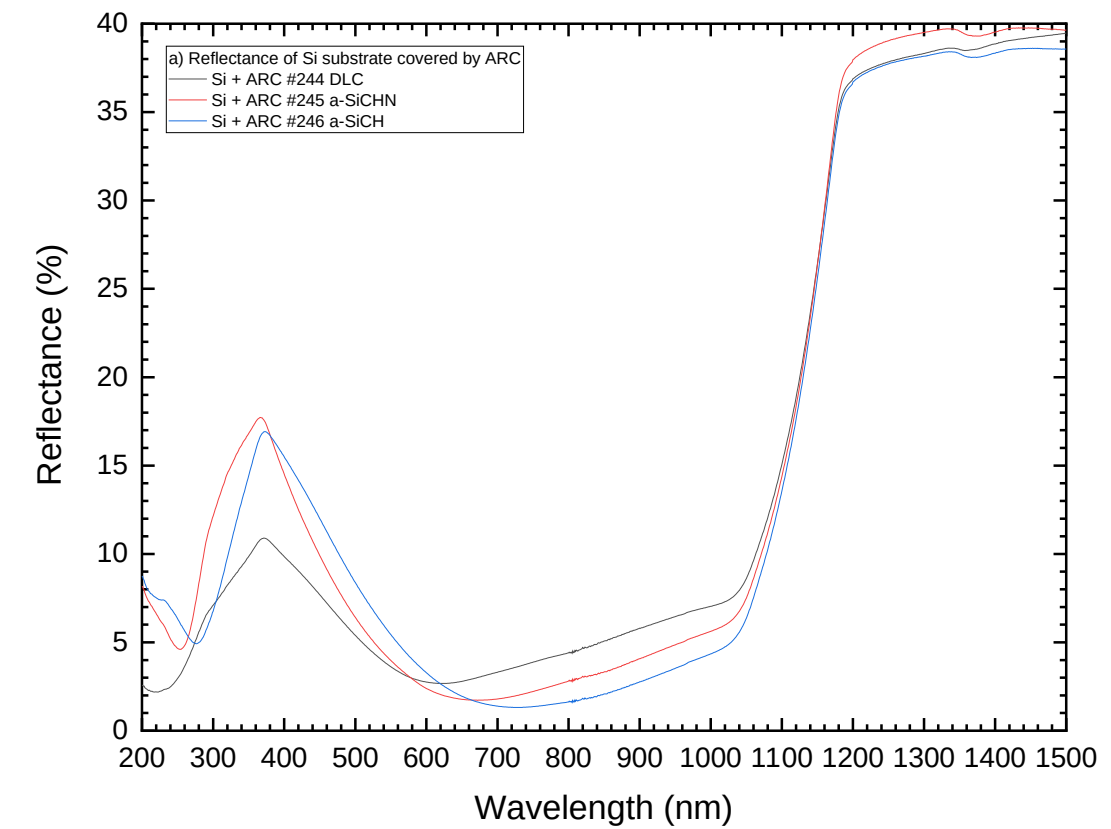
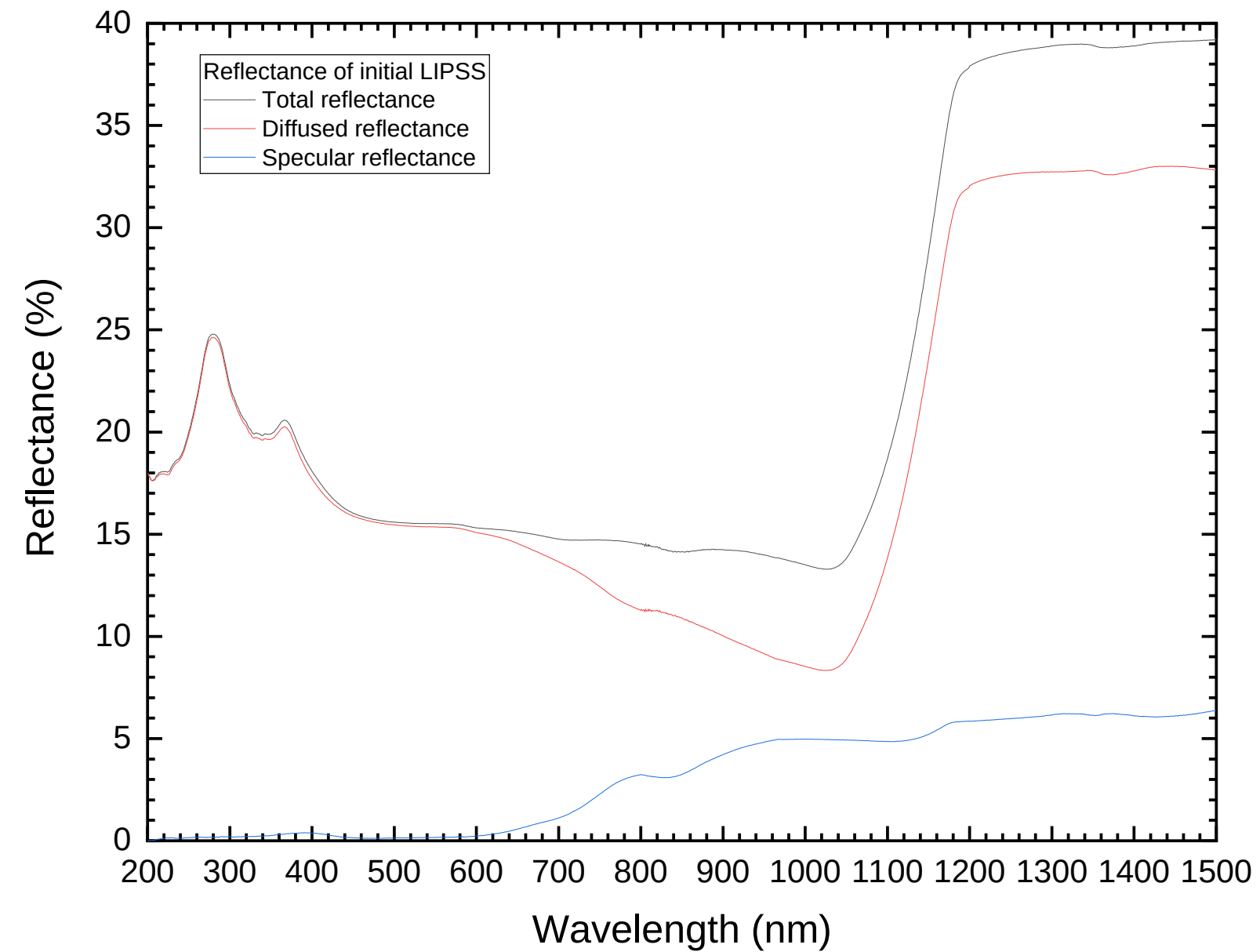
Scientific activity



c-Si solar cells treated with femtosecond laser and deposited with antireflective coatings



Laser treated surface of c-Si significantly improving its optical properties





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THANK YOU

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