



Method for Recycling of Precious Materials from Silicon-Based Photovoltaic Modules

SP Singapore Polytechnic

Technology Licensing Opportunity

Technology Overview

The solar industry faces an impending environmental crisis as 2.7 billion photovoltaic panels worldwide approach their 20-25 year lifespan, creating an unprecedented waste management challenge that threatens to undermine renewable energy's environmental benefits. The fundamental problem is that current PV recycling methods are economically and environmentally unsustainable: thermal treatment, chemical treatment, and thermal separation processes are cost-prohibitive, generate toxic chemicals, pose environmental hazards, and remain impractical for large-scale operations. Most critically, existing technologies only provide partial solutions - focusing solely on separating silicon solar cells from glass panels - leaving valuable materials like encapsulants, backsheets, and frames unrecovered, making recycling operations economically unviable.

This breakthrough technology eliminates these barriers by delivering the world's first complete end-to-end PV recycling solution that processes entire panels and recovers all raw materials and components including glass, encapsulating materials, silicon solar cells, backsheets, and aluminium frames. The innovative process is fast, cost-effective, and environmentally responsible without using toxic chemicals, transforming solar panel waste from an environmental liability into a profitable resource recovery operation that makes large-scale PV recycling both economically viable and environmentally sustainable for the first time.

Potential Applications

- Recycling of Photovoltaic modules.
- Recycling of display screen.

Commercialization / R&D Opportunities

- ✓ Ready for commercialization
- ✓ Looking collaborators for further development / to develop new applications
- ✓ Available for licensing
- ✓ Accepting business plans from interested parties

Intellectual Property -

- Patent Pending

Technology Features & Specifications

- Reduces the process time and costs for debonding operation
- Eliminates the need for large, expensive conventional furnace in the EVA removing process
- Reduces the energy and purging gas requirements for an EVA removing process
- Achieves high debonding efficiency
- Environmentally friendly and significantly reduce toxic gas release
- Highly scalable
- Fast & continuous, low cost and environmentally friendly process for disassembly of PV modules in pilot scale and mass production scale
- The process is ready for upscaling to full automation equipment and followed by commercialization
- Fast, low cost and environmentally friendly process for recycling of PV modules
- 95% material recovery rate
- Recycling into high-purity raw materials

Unique Value Proposition

- The growth of solar photovoltaic (PV) installations worldwide over the past decade has been extraordinary. With the global capacity increasing from around five gigawatts in 2005 to approximately 1.6 terawatts in 2023. In 2023, installations increased by almost 40%. The industry has seen an annual capacity and production growth rate of around 26%, doubling approximately every 3 years.
- Most of these modules are installed in Europe, however the Asian share of global annual installations is increasing rapidly.

Disclaimer

Although due care and attention have been taken to ensure that the preparation of this material is as accurate as possible, the contents of this brochure are provided for information purposes only. Neither the Singapore Polytechnic nor the inventors offer any warranty, written express or implied, as to the accuracy of the said contents. Applicants are advised to undertake independent evaluation of the technology.