

Key research directions for efficient separation technology

Technical Field	Key research development direction
Basic research	Accelerate the research on the bonding mechanisms between laminated component films such as ethylene-vinyl acetate copolymer (EVA) and polyolefin elastomer (POE) and various layers of materials including photovoltaic glass, battery cells, and back sheets. Focus on theoretical studies on the aging structural evolution of the films, the evolution of molecular bonding properties of the film particles, as well as the decomposition mechanism of the films under the combined effects of temperature fields, solvent medium environments, and physical external fields.
Physical method	Breakthroughs have been made in glass removal technologies such as low-cost winding, hot knife, peeling, cutting, and pulse fragmentation, as well as physical layer-by-layer stripping processing techniques applicable to double-sided modules. Research has been conducted on the automatic identification and positioning process of component defects based on machine vision and deep learning algorithms. Development has been carried out on multi-level series integration sorting systems and automated, intelligent physical high-purity layer-by-layer separation equipment to enhance the precision of component separation of the crushed materials.
Chemical method	<p>Solvent chemistry method: Accelerate the research on environmentally friendly, highly efficient dissolution rate and dissolution speed of reaction reagents, as well as microwave and ultrasonic-assisted gel dissolution technologies, to enhance the removal efficiency of the gel film. Develop solvent recycling technology to reduce process costs and minimize waste liquid generation.</p> <p>Pyrolysis chemistry method: Develop intelligent temperature-controlled automated and industrialized pyrolysis reaction equipment to achieve precise control of parameters such as reaction temperature and pressure, and efficiently utilize the residual energy from the reaction. Encourage the development and application of low-temperature pyrolysis methods (with a working temperature below 200 degrees), and develop efficient processing technologies and equipment for component pyrolysis of dust, to reduce environmental pollution.</p>

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Combination process of physical and chemical methods	Optimize the combined physical and chemical process flow design, enhance the separation efficiency, and reduce the energy consumption and pollutant emission levels in the process.
Other new separation processes	Promote the research on comprehensive utilization technologies for double-glass components, thin-film components and perovskite components. Explore low-cost methods such as freezing and high-temperature immersion for removing the adhesive films, as well as non-destructive separation and extraction technologies for low-value components like adhesives and back sheets. Encourage the development and pilot testing of separation processes for laminated components, including irradiation with light, laser interface peeling, supercritical carbon dioxide separation, fluidized bed pyrolysis, atmosphere pyrolysis, and solvent dissociation. Timely promote the industrial application of mature technologies.