Recycling of Si PV Solar Panels

Mechanical Engineering

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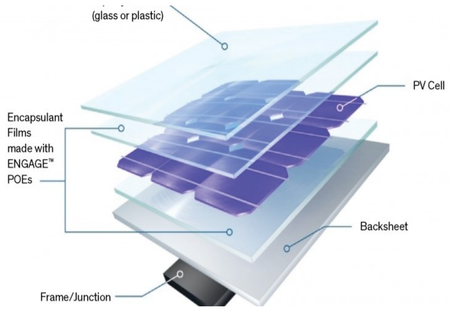
Abstract

The project presents about the chemical recycling of end of life PV panels and various processes involved in it. The recycling of PV panels includes two important steps: PV cell separation by thermal delamination process and then cleansing the surface of the cell by a chemical etching process. The cell is then recycled using a series of recycling steps conducted on the silicon extracted by the chemical etching process.



Design

Complete Module
Si PV Panel

Thermal processing
The panel is heated in a bed of SiO_2 at 1500C for 15 mins. The cells are separated.

PV Cell

Chemical Etching
20% aqueous aolution of KOH and NaOH were used to etch away Silver Coating, Aluminum Layer and P-N Junctions

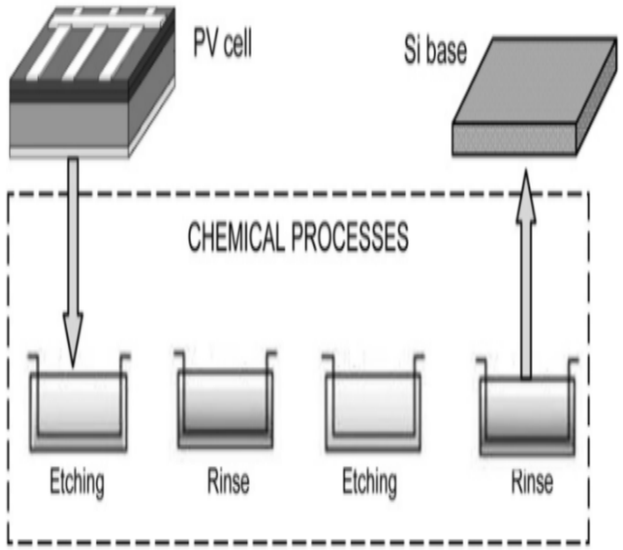
Si Chips

Silicon Processing
The silicon obtained can be used for making silicon ingot or cast into a new silicon chip. The silicon wafers can be cut from the ingot. Using these silicon wafers, we can reproduce the solar cells.

Introduction

Photovoltaics technology is undergoing a transition in which the researchers are able to produce low-cost and highly effective solar panels. By the year 2015, Si PV solar panels accounted for 93% of the total production. A current Si PV module has a life expectancy of 30 years. Simply disposing of these end of life panels is becoming an environmentally hazardous process. On the other hand, silicon, which is the main material in a PV solar panel, is expensive owing to its limited supply. Researchers have found out that silicon can be recovered from the spent cells and the damaged PV module can be remanufactured using proper recycling methods.

Chemical Etching Process



1. In a Teflon bath heat a 20% solution of NaOH and KOH to 60°C and submerge cell in bath with stirring for until visible bubbling has subsided.
2. Remove cell from first bath and submerge in DI water to rinse and dry completely.
3. Grind the silicon to a fine powder and place in a column. Heat the column to 60°C and run the etchants through the column of silicon. Collect the effluent in a flask.

References

[1] International Renewable Energy Agency(IRENA). End of life management: Solar Photovoltaic Panel. *IEA International Energy Agency, Photovoltaics Power System Programme*
[2] Wolfram Palitzsch and Ulrich Loser. Results from scaling up the universal chemical recycling procedure for CIS, CIGS and CdTe photovoltaic waste. *Loser Chemie GmbH*
[3] Ewa Klugmann, Piotr Ostrowski, Piotr Panek. Experimental validation of crystalline solar cells recycling by thermal and chemical methods *Solar Energy Materials and Solar Cells Journal* [Online]
[4] Haroon Ashfaq, Ikhlaq Hussain, Ajay Giri. Comparative analysis of old, recycled and new PV modules. *Journal of King Saud University – Engineering Sciences*

2017