Bonding thin films on textured Silicon heterojunction for tandem solar cell

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Tandem thin-film on silicon are considered the most promising architecture for the next generation of solar cells, with efficiencies over 30%. Still, there is no consensus on the architecture nor the way to integrate thin films on silicon (two or four junctions, direct deposition or bonding...). This project is part of PEPR TASE's targeted project IOTA (Innovative Tandem Cell Architectures). Its aim is to develop a new, low-cost, 2-terminal tandem solar cell architecture, by bonding a thin-film cell deposited on glass (CIGS or perovskite) to a silicon cell. Here, we report progress on bonding CIGS top solar cells on textured silicon heterojunction (SHJ) bottom cells. The bonding is based on a combination of insulating and conductive polymers, and compatible with rough and textured surfaces.

For a first proof of concept, we chose a CIGS top cell as it is low-cost, stable and provides an adjustable bandgap. The bottom SHJ features both micrometric texturation for light trapping purposes and millimetric stripes induced by saw damage. Both cells are prepared independently and assembled in a 2T configuration with an air cushion press providing gentle pressure and low temperature. The conductive bonding layers are made of a thick, insulating, planarizing IR-transparent resist, patterned with holes and coated with a thin conductive polymer to enable conduction between the two sub-cells. This hybrid polymer bonding layer is used to overcome the usual trade-off between conductivity and transparency. First results exhibit high transparency (~80%) for the bonding layer and good V_{oc} (1.3 V) for the tandem device. The overall efficiency is still limited by high series resistance and inhomogeneous bonding. Ongoing work is devoted to improve the planarization and investigate the origin of the series resistance.

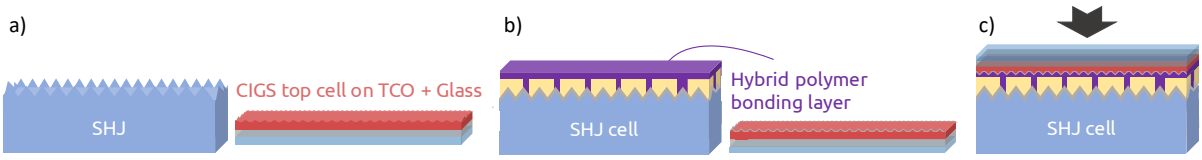

Fig 1 : a) Cells are prepared independently. b) transparent resist is used to planarize the textured bottom cell and patterned, and a conductive polymer is coated to fill the patterned holes and enable conduction between the top and bottom cells. c) Bonding at low pression and temperature (~150°C) in an air cushion press.

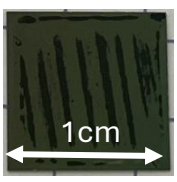

Fig 2: Photograph of a SHJ bonded on glass. Inhomogeneities are linked to the saw (black stripes).

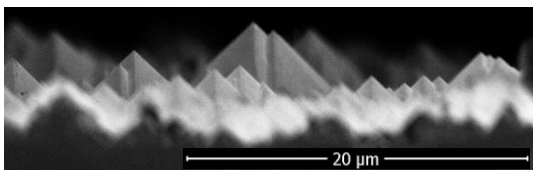

Fig 3: SEM picture of the SHJ pyramidal texturation.

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