

Patterned etching of dielectrics for High Efficiency Solar Cells

UNSW holds the world record for the efficiency of single junction silicon solar cell. The record of 25.0% was achieved using photolithography, which is too expensive for large scale commercial implementation. UNSW has developed new dielectric patterning techniques to replace photolithography.

The UNSW patterning techniques, which use inkjet printing and aerosol jet printing, are cheaper than photolithography. They avoid the use of expensive masks and mask aligners.

Digital images represent the etching patterns, so they are easily prepared and changed. The etching pattern is printed to form openings in a dielectric layer of silicon dioxide or PECVD silicon nitride.

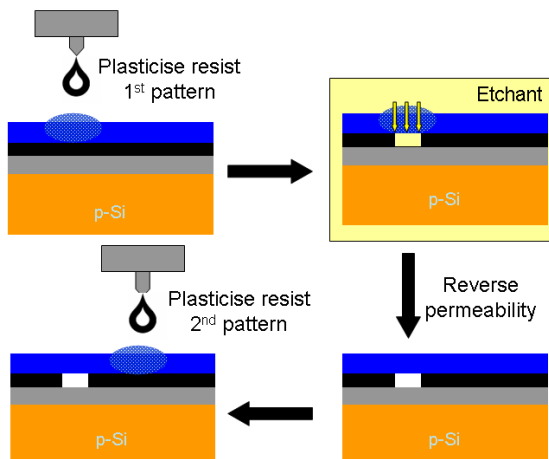


Lead Inventor Dr Alison Lennon in the Inkjet PV labs at UNSW

The 'resist' technique typically etches grooves of 45 μm width, and holes $\sim 40 \mu\text{m}$ in diameter. Under optimum conditions 30 μm narrow grooves have been etched. A single resist layer can be used for multiple patterning processes.

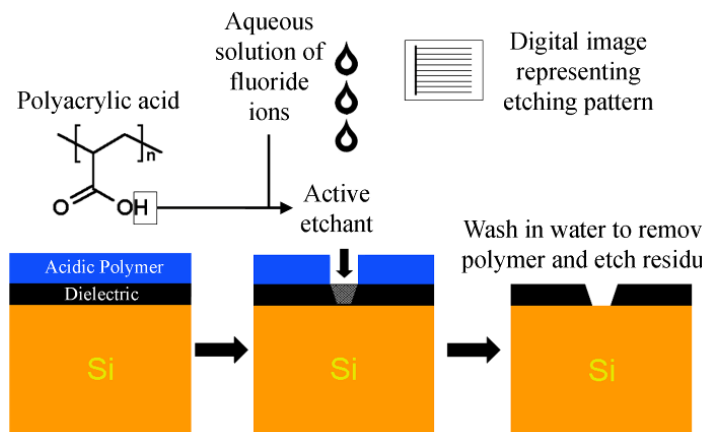
How the resist technique works:

1. A resist layer is formed over the dielectric surface.
2. Patterned deposition of a plasticizer forms permeable regions in the resist layer.
3. Aqueous etchants then permeate through the patterned resist areas, and etch openings in the dielectric layer.



Process of patented 'resist' technique

The 'direct' technique, requires fewer steps and uses less and cheaper chemicals than photolithography. The immersion etching step is not needed, and therefore large quantities of toxic and corrosive etching fluid are not required. This provides significant OH&S advantages by reducing operator training expenses and waste disposal issues.



Process of patented 'direct' technique

How the direct technique works;

1. An acidic polymer layer is formed over the dielectric surface.
2. A pattern of non-corrosive fluoride ions is deposited onto the polymer
3. The fluoride ions react with the polymer to form hydrogen fluoride (HF) locally, which then etches the underlying dielectric layer.

Using an aerosol jet printer, grooves narrow as 25 μm can be etched in a 75 nm thick PECVD silicon nitride layer. The etched regions can then be metal plated to form front metal contacts to the solar cell.

In addition, UNSW's dielectric patterning techniques can be used to create dielectric masks. These masks can be used to texture the silicon surface to enhance light capture into the cell.

UNSW's patterned etching of dielectrics advances the production of high efficiency solar cells for large scale commercial production.

To find out about licencing and partnering opportunities please contact:

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