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Surface effect key to self-assembly

US researchers hope for cheaper solar cells

by Claudia Flavell-While

Self-assembly could make solar cells cheaper more versatile

SELF-assembling solar cells could be a step closer to reality thanks to new research using the interactions at the oil-water interface to drive the assembly process.

Past attempts at self-assembly have mostly used gravity effects, or sedimentation, to drive the process, but these are ill-suited to dealing with small and light particles. Biochemical processes exploiting base pairing of DNA can be used to assemble devices at the nano-scale, but this leaves a significant range at the micrometre scale that is too small for gravimetric and too large for chemical assembly.

Now materials scientists Robert Knuesel and Heiko Jacobs at the University of Minnesota, US, say that oil-water interfaces – where hydrophobic and hydrophilic liquids meet but never mix – offer the perfect solution at this middle range.

In the latest issue of the *Proceedings of the National Academy of Sciences (PNAS)*, Knuesel and Heiko describe using the free energy at an oil-water interface to drive the self-assembly of 20 µm silicon solar chips into a functional array. Using such processes could make solar cells both significantly cheaper and would allow incorporation of photovoltaics into a much broader range of materials, they say.

The materials used in the study were so-called 'chiplets' – silicon cubes with side lengths of 20–60 µm, with a gold contact on one side. The gold surface was coated in a hydrophilic organic acid, while an organic methoxy-silane reaction increased the natural hydrophobia of the silicon. When added to an oil-water mixture, the researchers found that the chiplets assembled neatly along the liquid interface.

They then added a pre-prepared device blank, with depressions for where the chiplets should go, which were lined with a low-temperature solder. Slowly drawing the blank through the liquid at 95°C allowed the researchers to produce a working solar cell with some 64,000 elements in around three minutes.

With the proof of concept established, the team is now working to investigate the limitations of the size of the final product and the size of the individual chiplets. Further research will also scope the range of substrate materials that can be used for the blanks.

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