Energy Focus

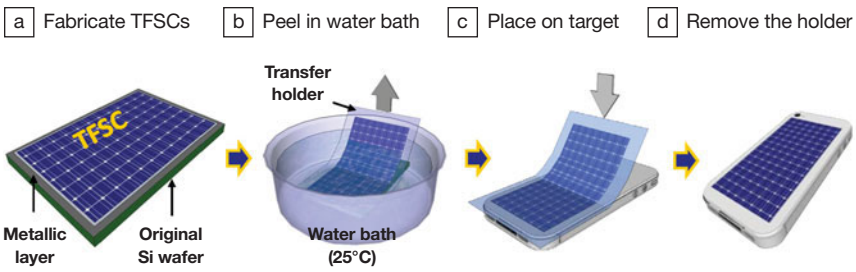
Peel-and-stick method transfers thin-film solar cells

Thin-film solar cells are currently prepared on temperature-resistant substrates due to the relatively high temperatures required for their fabrication. For this reason, they have been traditionally formed on thick silicon wafers or glass. The weight and rigidity of both these types of substrates greatly limit the range of applications of these solar cells in terms of portability, and also impedes their price for the end user. While thinner, flexible substrates are being explored to replace silicon during the fabrication process, they still need to be temperature-resistant. To dissociate the problem of the high-temperature deposition of the photovoltaic layers from the versatility required for commercialization, C.H. Lee from Stanford University, D.R. Kim from Hanyang University, N. William from the US National Renewable Energy Laboratory, and their colleagues recently introduced a way to efficiently transfer amorphous silicon thin-film solar cells from the fabrication substrate onto a variety of different substrates, including glass, paper, and plastic.

This technology is akin to transfer stickers favored by children. The thin-film solar cell is initially fabricated on a silicon substrate, and is then transferred onto a flexible intermediate transfer holder made of thermal release tape before being attached on the end substrate. Finally, the intermediate is removed by gentle heating (90°C). As described in the December 2012 issue of *Nature*'s *Scientific Reports* (DOI: 10.1038/srep01000), the key element of the transfer process is a 300-nm layer of nickel deposited between the silicon substrate and the actual solar cell. Once the solar cell is ready and tested, the transfer holder is attached on top and the covered solar cell is placed in a water bath at room temperature. The nickel layer unbinds from the silicon surface, thus separating the solar cell from its heavy fabrication substrate, as shown in the figure. The solar cell can then be placed onto a variety of end substrates.

Very importantly, the researchers show that the solar cells do not lose efficiency subsequent to the transfer process and that bending of the transferred thin-film solar cells does not degrade the photovoltaic performances.

Elsa Couderc



The "peel-and-stick" process to transfer thin-film solar cells to the end substrate. TFSC is thin-film solar cell. Reproduced with permission from *Sci. Rep.* DOI: 10.1038/srep01000. © 2012 Macmillan Publishers Ltd.

Nano Focus

Two-dimensional dielectric monolayer grown on metal-supported graphene

The formation of continuous interfaces between graphene and dielectric materials, as required for fabrication of various integrated devices, is problematic due to dewetting and thermal instability; most materials do not wet graphene because it has a low-energy surface. Recently, however, M. Batzill and co-researchers from the University of South Florida grew a complete monolayer of yttria (Y_2O_3), which displays a high dielectric constant, on Pt-supported graphene. The researchers showed that even though the Y_2O_3 monolayer interacts weakly with graphene, it is stable at high temperatures. Furthermore, their procedure is consistent with the growth of graphene on metal surfaces, so it holds the potential for large-scale heterostructure fabrication.

Batzill and co-researchers report in the December 23, 2012 issue of *Nature Nanotechnology* (DOI: 10.1038/NNANO.2012.217) that a uniform, two-dimensional, yttria monolayer was grown on graphene supported on a clean Pt(111) single crystal, using reactive vapor deposition at room temperature. Ordered structures appeared only after annealing above 550°C but characterization by LEED, STM, x-ray photoemission spectroscopy (XPS) and Auger electron spectroscopy (AES) was presented for samples annealed up to 700°C. The researchers showed that the graphene layer remains intact with no formation of covalent bonds between graphene and yttria. However, the yttria layer maintains rotational registry with the graphene, indicating a preferential alignment with respect to each rotational domain.

In order to test their expectation that yttria growth on other metal-supported graphene substrates is similar to that on Pt(111)-graphene, the researchers grew yttria films on graphene supported on Ni(111) and Ir(111) substrates. Measurement of the oxygen to carbon ratios as functions of deposition time gave values identical to those observed for yttria/graphene/Pt(111), demonstrating monolayer growth. Commenting on their results, the researchers said that "yttria functionalization of graphene may be incorporated into the formation of large-scale graphene wafers on various metal supports. Such yttria monolayers may act as an atomic buffer or nucleation layers between graphene and other materials in subsequent processing steps."

Steven Trohalaki