Towards photovoltaics on curtains

Development of various devices for consumption of solar energy offers a range of new possibilities for a customer. When I imagine how we can collect solar energy, the first impression is a massive barrel on the roof of my countryside house that is heated up on a sunny day and gives warm water to wash. The other well-known example includes a solar cell that converts energy of the solar light to electricity. Again, this example is usually associated with large silicon panels being installed either on the roof of a house or at the ‘solar farm’, i.e., a special field covered with hundreds of silicon panels. Yet these examples are far from elegant devices that could be easily accessible and controllable by a customer.

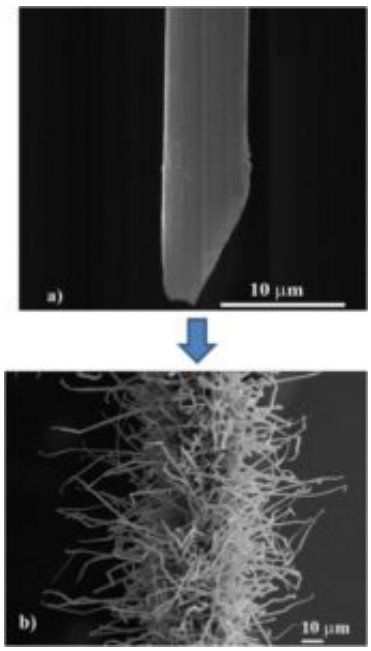

Fig. 1. Images of (a) bare carbon fiber and (b) CdS nanowire array grown on the carbon fiber.

Now imagine that we can get electricity by collection of solar energy in our house using some stuff in our kitchen and not to pay any bills for that. The tiny solar cells that absorb solar light and convert it to electricity can be incorporated into the wallpaper or curtains.

Fiber-shaped solar cells have attracted great attention recently in view of their potential integration into large-scale and low-cost textile and wearable electronic devices. We have demonstrated that a micron-sized solar cell can be assembled on a single carbon fiber whose diameter is as small as 10 microns, i.e., several times thinner than a human hairbreadth. Such an assembly can be then a part of the flexible cloth, such as curtains. Specifically, nanoscale hybrid solar cells of four different types were assembled on a carbon fiber which served as a conductive core electrode. The

principal elements that produce electricity upon light irradiation in such an assembly are two semiconductor layers deposited in the form of two successive shells. The first one was inorganic CdS nanocrystals in the form of a brush of radially oriented nanowires around the fiber core (Fig. 1) which were grown via a high-temperature process. The second shell was an organic semiconductor layer (organic dye or polymer) deposited through soaking of the above brush into the special ink solution; this layer served as a major material to absorb light. Finally, a transparent conducting polymer layer was attached as a counter electrode in the assembly (Fig. 2).

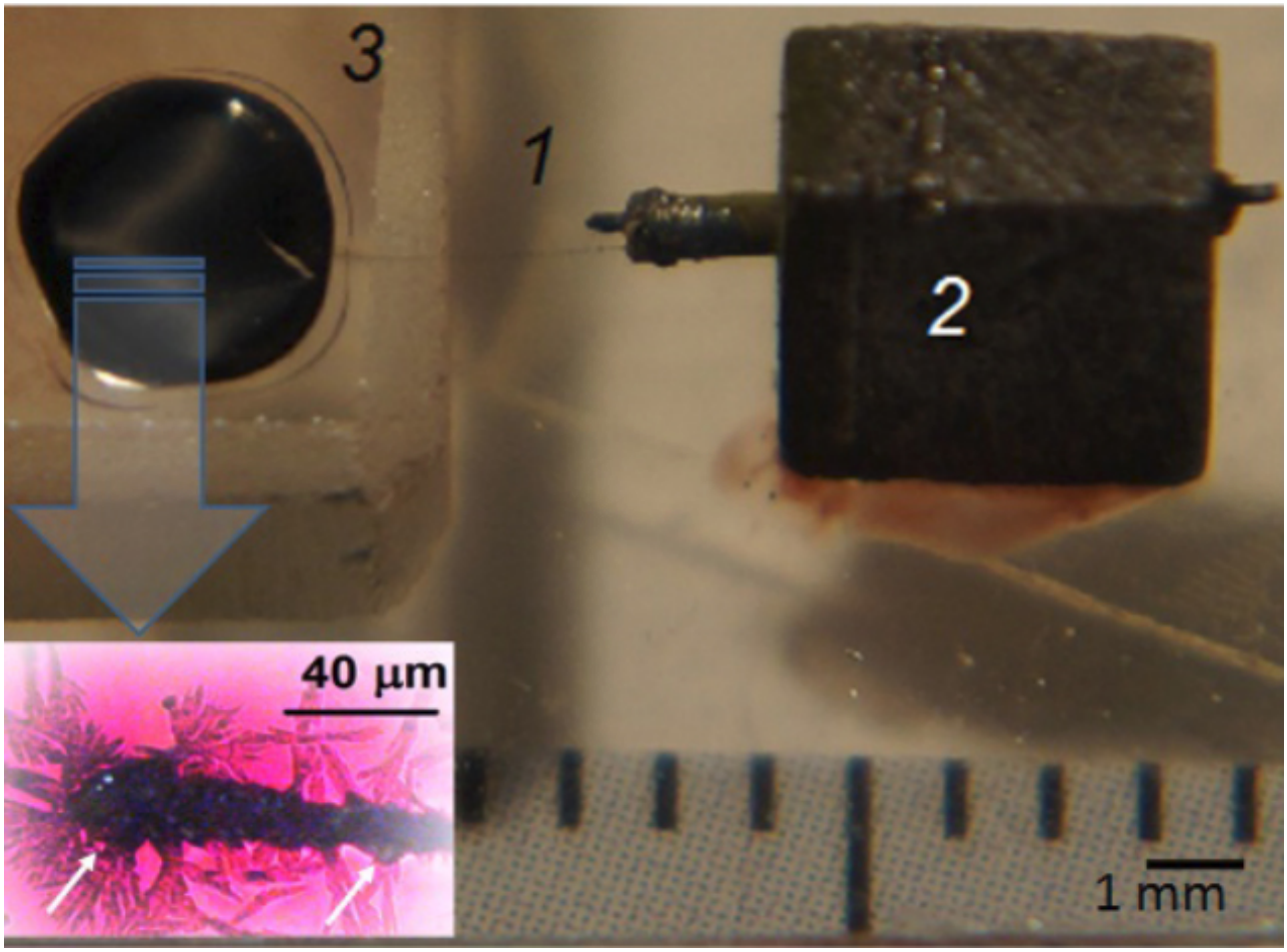

Fig. 2. The assembled solar cell: 1- carbon fiber, 2- supporting conductive block, 3- ITO/PEDOT:PSS counter-electrode. The insert shows enlarged CdS nanowire assembly after its soaking with the ink polymer solution; some nanowires become broken and the arrows clearly show the polymer droplets.

Yet, the above technology does not provide acceptable photovoltaic performance and the developed solar cells need substantial optimization. However, as we proceed from the era of fossil energy sources to renewable energy, the perspective to have photovoltaics on curtains becomes

more actual and attractive.

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Publication

Hybrid solar cell on a carbon fiber.
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