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Solid State Dye Sensitized Solar Cells: Possible Low-Cost Alternatives to Silicon

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The world energy consumption is rising, which makes the limitations of fossil fuels more and more apparent. Oil prices are as high as ever. If there is no solution to finding a cost effective and accessible renewable energy source, then the energy problem will become critical soon.
This is certainly one reason that the market of solar cells is one of the fastest growing, despite the fact that the production of conventional silicon solar cells, with conversion efficiency of 15%, is expensive. Also they consume high energy during fabrication and the economic payback time is long, due to the elaborate processes that are involved in their production. Therefore, the interests and the perspectives for low-cost solar cells are very high. The energy payback time is also as critical as the economic one, e.g. the Latent Class Analysis evaluation of solar plants based on polycrystalline silicon cells, is calculated at 10 years in favourable exposure conditions. This means that polluting emissions of greenhouse gases will be reduced in the timescale of about 10 years, but in the near future it could consist in a strong increment of these.
A possible alternative on silicone solar cells are solid-state dye-sensitized solar cells, which are considered as a promising technology having the potential to significantly decrease the costs of solar energy.
The breakthrough was achieved in 1991, when Grätzel's group developed the first dye sensitized solar cell, with the demonstration of a system reaching more than 7% conversion efficiency. At the moment Grätzel's solar cells with a liquid electrolyte are achieving 11%. After two decade of intense research the commercialization is in reach.
They have attracted considerable interest on the scientific and production community due their low-energetic production cost and low-cost raw materials, which offer the perspective of very low-cost fabrication. Also, their deposition not asks application of extremely sophisticated technologies, as in the case of silicon solar cells and they can be incorporated in present industrial processes.
Solid state dye sensitized solar cells consist of a nanoporous interpenetrating network of n-type material (e.g. TiO2), dye layer like Ru organo-metallic compounds, that collect the light and transfer an electron to the n-type semiconductor and a p-type semiconductor that collect the holes (e.g. Spiro-OMeTAD). In some cases dye and p-type semiconductor can be constituted by the same material (e.g. CuInS2). All inorganic TiO2/CuInS2 solar cells have achieved energy conversion efficiency grater then 5% and because of the kind of technology implied it shows a promisingly possible integration with the building industries.

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