3D printable solar cells

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Abstract
This offer concerns solar cells produced by 3D printing of semiconductor layers on a plastic foil that acts as carrier material. Such printed solar cells are very cheap in comparison to the conventional solar cells, and the fact that the carrier material can be rolled up creates new possibilities for constructing scroll-like replaceable solar panels, in which the degraded part of the foil is regularly replaced by new cells that have not yet degraded under influence of radiation.

Description
Solar cells are increasingly popular as a source of electricity, and often form the only option for providing power to systems that are mobile, located on remote places, or otherwise not connected to alternative sources of electricity. This is particularly true in space, where solar cells have been used in space since the very first years of space exploration and remain the first choice for generating electricity. Conventional silicon-based solar cells have reached a mature level of development but remain expensive to produce, relatively inefficient, and sensitive to degradation in an aggressive radiation environment. The technology on offer concerns 3D printed solar cells complete with leads for anode and cathode, typically printed on low cost plastic foil or other cheap carrier material. The electrical efficiency of these 3D printed solar cells is still lower than that of conventional solar cells, but the production cost are so much lower than those of conventional solar cells that the cost-effectiveness of 3D printed cells is far superior to that of conventional cells. The 3D printable solar cell consists of a small multi-layered electronic circuit of light-sensitive material in combination with another semiconductor material, together acting as anode and cathode under the influence of incoming light. The printed cells are completely flat, and can be produced at extremely low cost on large rolls of carrier material, such as transparent plastic. For a given power budget, the rolls of printed solar cells can be considerably lighter than conventional solar panels. If the roll is constructed like a traditional scroll, with both rolled-up sections protected against incoming radiation, only a small part of the roll is used at any time to generate electricity. After degradation of this section under influence of space radiation, the foil can be rolled further in order to expose a new section of unused cells, similar to the lint on an old typewriter. In this way, a cheap and light alternative may be constructed to conventional solar panels, with potentially a much longer operational life than
silicon-based panels of the same launch weight. The technology has been developed for use on spacecraft, high-flying drones and similar aerospace applications but is highly suitable for applications in non-space environments where cheap solar power is of interest.

**Innovations and advantages of the offer**

3D printed solar cells are significantly cheaper to produce than conventional silicon-based solar cells, have significantly lower weight for the same electricity output, and can be rolled into flexible “scroll” structure to extend the operational lifetime of the solar panels. In space applications, this can allow significantly larger solar panels for the same launch weight which will be of particular interest to satellites with electric propulsion systems (e.g. second generation Galileo, and increasingly large numbers of geostationary communication satellites that are launched to Low Earth Orbit, and then gradually pushed to their destination orbit with ionic thrusters. This practice is popular because of the significant reduction in launch cost, an effect that may be emphasized if the cost of the required large solar panels can be reduced. Also, due to the flexibility of the carrier material, solar panels can be produced in complex shapes, for instance for following the aerodynamic shape of an airplane or similar body. The foil with solar cells could be integrated in the curved roofs of cars, on cylindrical lamp posts, or similar curved surfaces without adding significantly to the weight of the structure.

**Further Information**

The DisaSolar Company is part of the Disa/Megamark group, which is primarily known for its printing technology. The DisaSolar activity focuses on cutting-edge organic solar technology (OPV) via R&D with partners such as CEA, CNRS, CNES, and some universities.

**Application**

Potential domain is in large semi-disposable solar panels, in particular relevant for satellites with electric propulsion systems.

**Comments on the technology by the broker**

The originator provides conventional solar cell solutions both to the space domain and non-space domain (e.g. buildings). The possibility of 3D printed solar cells is new, and not yet used in either space or non-space applications. Use in space domain seems highly attractive due to the extremely low weight and low cost of manufacturing, allowing very large panels, even replaceable orrollable panels similar to what was used on the Hubble Space Telescope.

**Potential Domain of Application in Space**

Large solar panels in support of electric propulsion systems, for instance on the second-generation Galileo satellites and similar applications.

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