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Nighttime solar cells

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Energy demand from the electrical grid is substantially higher during evening times when solar panels cannot contribute to electrical power generation. The fact that solar cells only produce energy during daytime necessitates their costly integration with expensive storage components. At the present cost levels, even a solar panel operating at the theoretical maximum of 70% power conversion efficiency would not be competitive with fossil fuels due to the cost of batteries used to dispatch solar power at night. Here we introduce a new family of photovoltaics capable of generating power in the dark by exploiting the afterglow redox properties of strontium aluminate, a persistently luminescent (PL) material, in a way that, even after 9 hours operation in the dark, our photovoltaics still produce an afterglow short-circuit current that is 75% of the amount generated immediately after illumination. We demonstrate that our "nighttime" photogeneration system can be integrated into dye-sensitized solar cells, and, potentially, other types of photovoltaics for optimized power generation during daytime and nighttime. our work offers unique advances in the photo-physics of PL materials through the invention and operation of nighttime solar cells. Although 1-sun power conversion efficiency from our devices is apparently low (1%), overnight electrical power generation from afterglow currents make them uniquely competitive on the energy market, because low efficiency under illumination is at least partially compensated by power storage and release in the afterglow.

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