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Use 200x less material! Solar cells based on the Cu_2ZnSnS_4 compound

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For solar energy to really compete with fossil fuels for production of bulk grid power, its cost needs to be further decreased. Conventional silicon-based solar cells have almost reached their theoretical efficiency limit and their cost is dominated by the cost of the high-quality silicon crystal needed for high-efficiency solar cells. The new photovoltaic material Cu_2ZnSnS_4 (nicknamed 'CZTS') is a promising alternative since it absorbs light about 200 times more strongly than silicon and therefore can be made 200 times thinner, greatly reducing material costs (Figure 1). Further, CZTS only contains earth-abundant, environmentally-friendly elements and requires a lower processing temperature than conventional solar cells, so it is a viable candidate for Terawatt-sized solar energy production. Its potential theoretical efficiency is as high as conventional solar cells (more than 30%), but current record efficiencies are still below 10% [1].

Our strategy is to produce CZTS films by 1) a research-oriented vacuum method (pulsed laser deposition) for studying the material's properties, and 2) an industry-friendly wet chemical method (spin/spray coating of nanocrystals in a liquid solution) for large-scale production. Preliminary conversion efficiencies of 2.1% have been measured on solar cell devices fabricated by our group using a glass/Mo/CZTS/CdS/ZnO/ZnO:Al stack (Figure 1,2) and further optimization is underway.

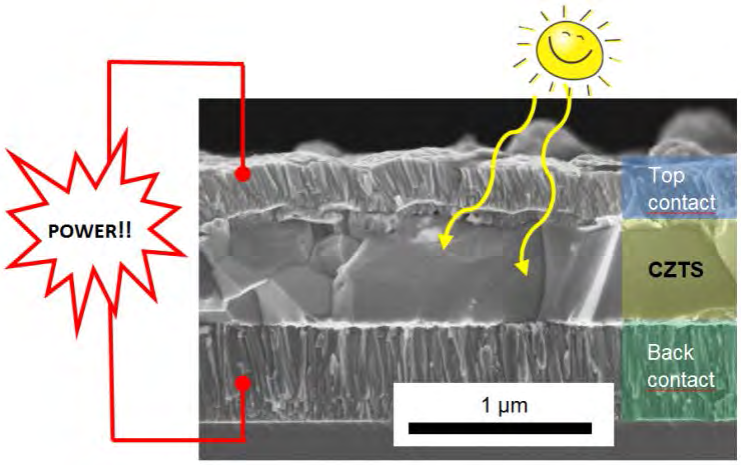

Figure 1. Cross-sectional view of a CZTS solar cell produced by our group.

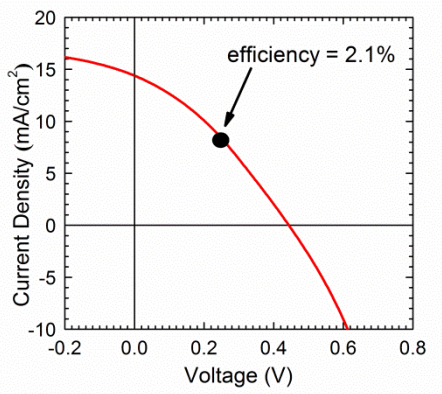

Figure 2. Current-voltage curve of our best solar cell under standard illumination

[1] S. Tajima, T. Itoh, H. Hazama, K. Ohishi, R. Asahi, *Appl. Phys. Express* **2015**, *8*, 082302.