Ceramics for Symbiosis with Global Environment

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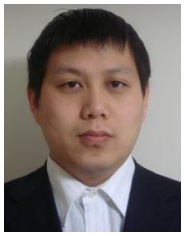

Associate Prof. Feng DANG

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PV/TE Hybrid Device & High-effeciency Thermoelectric Materials

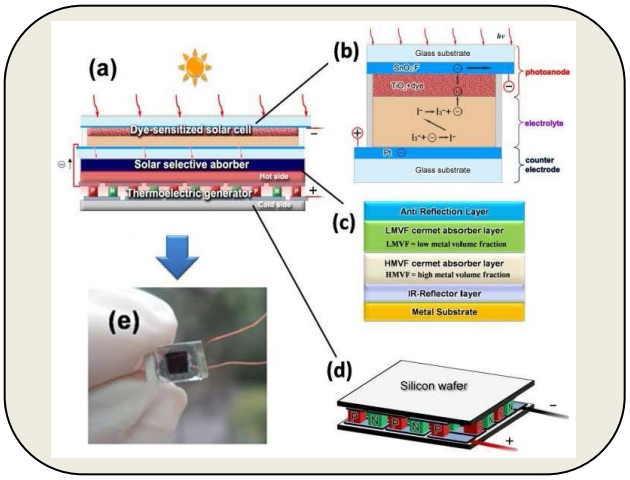
In order to recover the vivid earth avoiding environmental disruption, global warming, and climate change we must get out of the fossil fuel/nuclear energy-based society and challenge to construct the "Solar Energy-based Society" which would make the most use of natural clean energy.

We make tremendous efforts to develop thermoelectric materials that would contribute to utilizing solar energy with high efficiency with low cost.

Description of R & D

1. A novel solar-energy harvesting hybrid device with a dye-sensitized solar cell and a thermoelectric module connected in series has been developed. The energy conversion efficiency of 13.8 % was achieved by a hand-made hybrid device with a commercial TE module. Simulation with an equivalent circuit model indicates that more than 20 % efficiency can be obtained if a TE module is optimized.

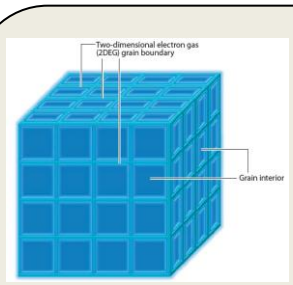
2. Novel thermoelectric materials that could be applied to operations at 300 – 700 K in air are under development. Our concept is to embed nanostructures having quantum confinement effect and interface effect with 3D bulk materials to enhance the efficiency.



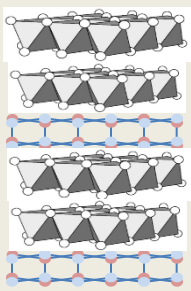
Originality & Creativity

1. A PV/TE hybrid device is our original proposal for Solar-energy harvesting in the future.
(N. Wang, K. Koumoto et al., *Energy Environ. Sci.*, 2011)

2. 3D superlattice ceramics of $SrTiO_3$ and TiS_2-based natural superlattice materials are our original materials.
(R.Z. Zhang, K. Koumoto et al., *J. Am. Ceram. Soc.*, 2010;
C.L. Wan, K. Koumoto et al., *J. Electron. Mater.*, 2011)



(1) $SrTiO_3$-based 3D superlattice



(2) TiS_2-based natural superlattice