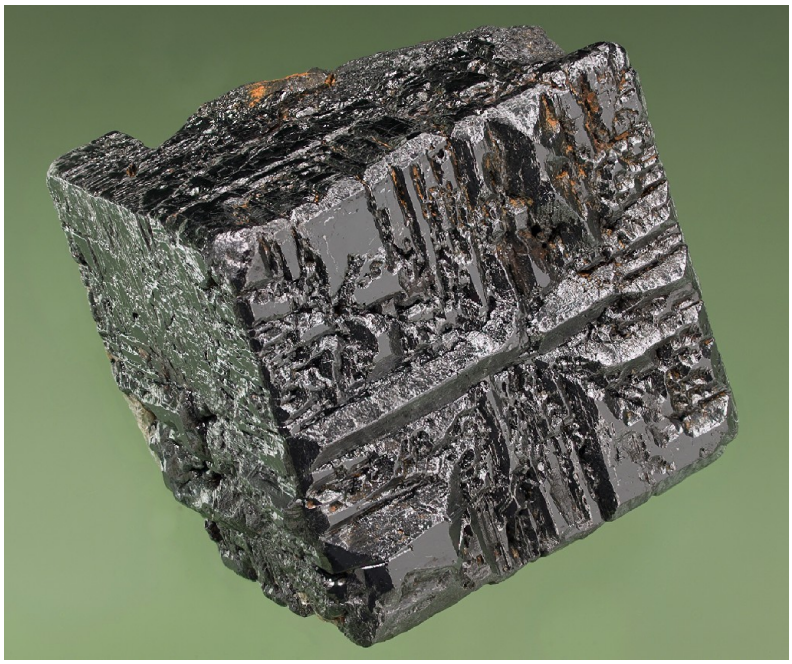
Perovskite Solar Cells

Kalliopi Chourdaki
mst 1079

A new technology was raised the past few years to the photovoltaic community, featuring solar cells based on organic-inorganic metal halide perovskites (Perovskite Solar Cell, PSC). Perovskites are materials described by the formula ABX_3, where X is an anion, A is a cation and B is cation smaller than A. More specifically, for these PSCs: [2]

- A: Organic cation. Mostly used: methylammonium ($CH_3NH_3^+$)
- B: Cation. Mostly used: lead (Pb)
- X: Anion, Halogen. Mostly used: iodine, bromide, chloride (I, Br, Cl)



Picture 1: Perovskite, (Calcium titanium oxide), Photographer: Tony Peterson, Achmatovsk Mine, Southern Urals, Russia.

When PSCs were first introduced in 2009, they converted 3.8 % of sunlight into usable electric power and now their power–conversion efficiency (PCE) has overcome 22%. [1]
They are the fastest-advancing solar technology to date with great prospects on further research and commercialization.
On this presentation we will address the structure of a perovskite solar cell, how it works and it's photovoltaic characteristics.[1, 5]

On a more specific issue

In the context of research on PSCs, nanoparticles (NPs) of different metals (Au, Ag, Al) where inserted into the PSCs and they were compared to the pristine one (with no NPs).[4]

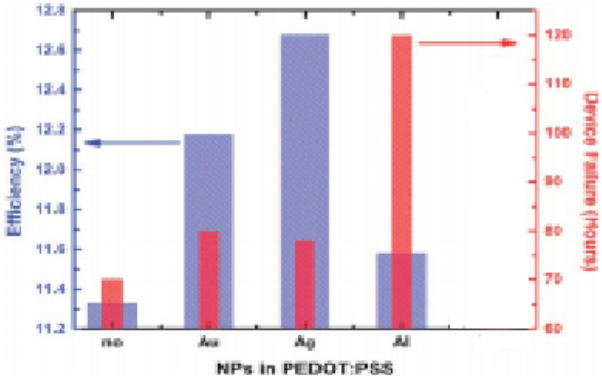


Figure 1:General overview of the results, Paper: Efficiency and stability enhancement of inverted perovskite solar cells via the addition of metal nanoparticles in the hole transport layer [4]

The PCE and the stability of the device were enhanced in the NPs – doped PSCs, but it was only for two of them that the difference was of significance. The problem was that when the degradation trend of the device was slow, the PCE was really low, so it wasn't possible to achieve both efficiency and stability enhancement.

Or was it?

References

[1] Michael Grätzel, Nature Materials, Vol 13, (September 2014)
[2] Martin A. Green, Anita Ho-Baillie, Henry J. Snaith, DOI: 10.1038/NPHOTON.2014.134

[3] Oscar Grånäs, Dmitry Vinichenko, Efthimios Kaxiras, Scientific Reports 6, 36108, (2016)

[4] G.Kavalekakis, K.Alexaki, E. Stratakis, E,Kymakis, RSC Adv, 2017, 7, 12998

[5] Jasprit Singh, Semiconductor Optoelectronics, Physics and Technology, 1st Edition, Chapter 7