Researchers develop thin films showing promise for solar applications

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Researchers at Ben-Gurion University of the Negev have developed thin films that exhibit carrier multiplication (CM). This development is of great interest for future solar cells.

The films were synthesized at BGU by Prof. Yuval Golan and PhD student Anna Osherov of the Department of Materials Engineering and the Ilse Katz Institute for Nanoscale Science and Technology. The letter was published this week in Nature Physics.

One of the important factors limiting solar-cell efficiency is that incident photons generate only one electron-hole pair, irrespective of the photon energy. Any excess photon energy is lost as heat.

Carrier Multiplication (CM) has been thought to be enhanced significantly in nanocrystalline materials such as quantum dots, owing to their discrete energy levels and enhanced Coulomb interactions.

The BGU team demonstrated that contrary to this expectation, for a given photon energy, carrier multiplication occurs more efficiently in bulk PbS and PbSe films than in nanocrystalline films of the same materials.

"Films developed at BGU show CM, in which each incoming photon (tiny quantity of sunlight) creates more than one electron-hole pair," Golan explains. "This can potentially be used for making more efficient solar cells. The new physics behind this work are that while CM has been

mostly demonstrated in nanocrystalline materials ("quantum dots"), we now show that CM can be obtained also in single crystal ('bulk') films of lead sulfide and lead selenide."

Notably, the films were prepared using chemical solution deposition, an attractive, inexpensive deposition technique for which the Golan group at BGU has received considerable recognition. The research was carried out as part of an international collaboration with counterparts in France and the Netherlands.

More information: J.J.H. Pijpers, R. Ulbricht, K.J. Tielrooij, A. Osherov, Y. Golan, C. Delerue, G. Allan and M. Bonn, "Assessment of Carrier Multiplication efficiency in bulk PbSe and PbS", *Nature Physics* (2009) in press.

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