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ECE SEMINAR

Chalcopyrite PV on its path to Shockley-Queisser parity

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TALK TITLE:
CHALCOPYRITE PV ON ITS PATH TO SHOCKLEY-QUEISSER PARITY

The photovoltaic (PV) market has long been dominated by crystalline silicon-based technologies. Their success is rooted also in the laboratory, with record efficiencies ultimately approaching the theoretical limit for monocrystalline silicon. Market competitors are Cu(In,Ga)(S,Se)2 (CIGS aka chalcopyrite) and CdTe thin films. Currently, the commercial attractiveness of CIGS is curtailed by the module efficiency gap and by the supply of critical raw materials, with respect to silicon.

Overcoming the Shockley-Queisser efficiency gap requires the pursuit of strategic approaches, leaving plenty of room for research at both industrial and laboratory scale. Likewise, the availability of critical raw materials may constrain the future deployment of CIGS at GW scales needed for the ecological transition. The progress on both fronts poses compelling scientific challenges.

This contribution starts with outlining the large opportunities offered by a concerted effort on wide-gap chalcopyrite. It then reveals a novel strategy making use of ferrofluids to explore the large scale fabrication of microconcentrator solar cells, promising to reduce critical raw materials needs by one to two orders of magnitude. Here, insights are drawn from recent and older literature on narrow-gap chalcopyrite with the ambition to fully unlock the potential of the material and afford efficient dual junction chalcopyrite PV devices through a paradigm shift in microfabrication.

BIOGRAPHY

Diego Colombara is Associate Professor of Inorganic Chemistry at the University of Genova (Italy). His Master studies in Italy and UK focused on solid state chemistry and metallurgy, with emphasis on phase equilibria, crystallography and alloys microstructure. His doctorate at the University of Bath (UK) was devoted to the synthesis and photoelectrochemical characterization of Earth-abundant chalcogenides for PV applications by electroplating and reactive annealing, as well as by chemical vapor transport (EPSRC-funded project SUPERGEN, 2008-2012).

His PhD advisor was Prof. Laurie M. Peter, pioneer of semiconductor (photo)electrochemistry. Prof. Colombara acquired 5 years of postdoctoral research and teaching experience within the Physics department at the Unversity of Luxembourg, including 3 years as researcher in FP7 project SCALENANO and 2 years as the Principal Investigator of GALDOCHS (a research project funded by the FNR), where he discovered, studied and developed a novel methodology for extrinsic doping of PV semiconductors that enabled to refute a 20-years old assumption on CIGS PV technology.

Diego joined the University of Genova after 2 years of Marie Curie fellowship at INL (Portugal). He is the inventor on a patent that represents the basis of REMAP, a 4M€ collaborative project funded by the European Innovation Council. He has authored more than 40 articles.