Dipartimento di Chimica
Sapienza
Università di Roma

$Cu(In,Ga)Se_2$-based solar cells: Does sodium hinder or enhance In/Ga interdiffusion?

Dr. Diego Colombara, *University of Luxembourg*

Giovedì 9 giugno, ore 12:00, sala Parravano

Solar power has the potential of supplying a large part of humankind's energy needs in the near future. If we were to meet the total power demand of the world from solar we would have to scale up research on energy storage, high temperature superconductivity, sustainability of material supply as well as improve the "Sun to electricity" conversion efficiency.

After a short introduction on the physics of photovoltaics, I will provide an overview of the current progress of $Cu(In,Ga)Se_2$ (CIGS)-based solar cells. This type of thin film solar cells holds the world record efficiency (22.3 %) among single junction devices after monocrystalline silicon and gallium arsenide technologies.

I will emphasize the role of sodium doping and gallium depth concentration gradients as essential factors to achieve the highest power conversion efficiencies. My recent research has identified a new correlation between these two factors. Unlike previously thought, sodium has the potential of increasing the In/Ga interdiffusion rate in CIGS. This was observed on monocrystalline $CuInSe_2$ films grown on GaAs and subject to sodium incorporation via a novel gas phase route. I will introduce a plausible physical-chemical explanation to account for the enhanced In/Ga interdiffusion. This explanation extends the collision theory of chemical kinetics to diffusion processes in solids.

Finally, I will introduce research currently ongoing in collaboration with Sapienza, Versailles and Genova with the aim of unveiling the actual mechanism of alkali incorporation via the gas phase.

Diego Colombara was awarded a PhD in Chemistry by the University of Bath (UK) in 2012 with a thesis on chalcogenide materials for solar cell applications supervised by Prof. Laurie Peter. His PhD research focused on Cu_2ZnSnS_4 (CZTS), $CuSbS_2$ and Cu_3BiS_3. He is currently a CORE Junior fellow at the University of Luxembourg where he works as the principal investigator of a project on gas-phase alkali doping of chalcogenide semiconductors (GALDOCHS) funded by the national research fund of Luxembourg. Previously, he has spent three years at the same institution working on an FP7 project (SCALENANO), where he looked at photoelectrochemistry as a predictive and monitoring tool for solar cell performance. His research interests include thin film electrochemical deposition, metal to chalcogenide conversion by reactive annealing, single crystal growth by chemical vapour transport, molten carbonate fuel cells and raw materials availability for photovoltaic energy exploitation.