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“In situ Investigation of Lead Iodide Formation and the Influence of Cations on the Two-Step Hybrid Perovskite Solar Cells”

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Perovskite solar cells have attracted significant interest thanks to the impressive rise of their efficiency over the last few years to power conversion efficiency (PCE) of 25.5% in 2020. They are considered as an alternative to the existing expensive semiconductors due to their cheap and easy fabrication and processing potentially through solution coating techniques and their abundant elements. Using the two-step conversion process, high-quality perovskite films with high-quality and uniformity can be produced, however, this process still needs a deeper and fundamental understanding. In this presentation, we will introduce time-resolved investigation of the ink-to-solid conversion during the two-step solution process of hybrid perovskite formulations to study the solid-state microstructure and the solar cells devices' properties in terms of the ink's formulation, drying, and solidification process. We used several in situ diagnostic measurements such as grazing incidence wide-angle x-ray scattering (GIWAXS), quartz crystal microbalance with dissipation monitoring (QCM-D), and optical reflectance and absorbance all performed during spin coating, to monitor the nucleation and growth of crystalline phases, the mass deposition at the solid-liquid interface and the rigidity as well as the solution thinning behavior and the changes in optical absorbance of the precursor and perovskite. We demonstrated that the conversion of PbI_2 to perovskite is largely dictated by the state of the PbI_2 precursor film in terms of its solvated states from where the conversion can occur spontaneously and quite rapidly at room temperature without requiring further thermal annealing. Besides, we show that the choice of the cations determines both the conversion to perovskite and the optoelectronic properties of the devices as well as impacts the PCE of the solar cells.

Biography:

Dr Dounya Barrit obtained a Ph.D in Material Science and Engineering from King Abdullah University of Science and Technology (KAUST), Thuwal, Saudia Arabia. She also received a Master of Science Degree in Sustainable Energy Management and a Bachelor of Science Degree in Engineering and Management from Al Akhawayn University of Ifrane, Morocco. Dr Barrit worked extensively on developing processing-structure-property-performance relationships in hybrid perovskites and her research interest focus on bridging the lack of understanding in the liquid-to-solid phase transformation process during two-step deposition of hybrid perovskites and using this knowledge for improving the thin film quality for efficient solar cells. Presently, she is joining her expertise on the characterization of semiconductors' materials, thin films deposition techniques, in situ investigation of phase transformation processes and perovskite solar cells to the amazing facilities at the Green Energy Park (GEP)/ Institut de Recherche en Energie Solaire et Energies Nouvelles (IRESEN) as the Head of Perovskite and Novel Photovoltaic Technologies Group.