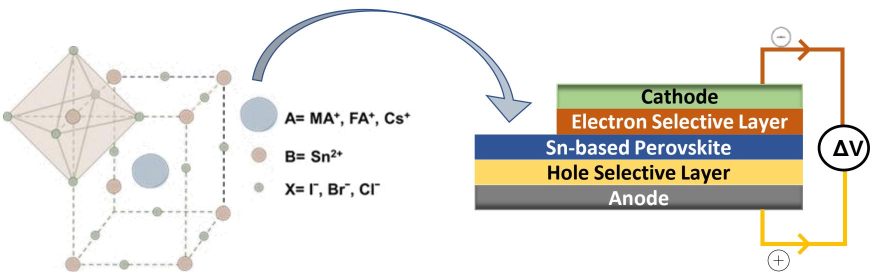
A NEW CLASS OF ECO-FRIENDLY LEAD-FREE PEROVSKITES

Ece Aktaş – Advisor: Prof. Antonio Abate

Curriculum: Ingegneria Chimica

Lead-based perovskite solar cells are attracting a great deal of attention from the global renewable energy market owing to their high-power conversion efficiency and ease of application. Whereas lead is a potent poison and even minor exposures can have devastating and lasting effects on people and the environment. Although its power conversion efficiency is comparable to silicon solar cells, its high toxicity will be one of the biggest challenges for its commercialization in the coming years. For this reason, lead-free perovskite solar cells have been explored by replacing Pb^{+2} with promising less toxic ions like Sn^{2+}, Bi^{3+}, Ge^{2+}, Sb^{3+} and, Mn^{2+}, etc. Moreover, Sn-based perovskites exhibit similar superior optoelectronic properties as Pb-based perovskite. Furthermore, Sn-based perovskites show narrower optical bandgaps (1.2–1.4 eV) and higher carrier mobilities than the Pb-based counterparts. Hence, Sn-based perovskites are more favorable for eco-friendly efficient single-junction photovoltaic devices.

The aim of this thesis will be to improve the efficiecny and stability of Sn-based perovskite solar cells by applying different processing conditions and compositions (e.g. A-cations mixtures like Cs/formamidinium or multi-cation perovskites). In addition to this, the use of reducing agents during processing conditions will be studied to stabilize Sn(II). The chemical, structural, morphological and optical characterisations of Sn-based eco-friendly perovskites will be done using XRD, FTIR, NMR, AFM, SEM and PL. To determine the stability of the completed Sn-based perovskite devices under actual working conditions, the maximum power point will be performed with obtained accurate efficiency value.



Ece Aktaş, PhD student XXXVII cycle, July 2022