

### Project 3.3 Environmental-friendly and highly efficient perovskite solar cells

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**www:** <https://ichf.edu.pl/zespoly/materialy-polprzewodnikowe-i-urzadzenia-optoelektroniczne>

#### Background:

Solar energy is one of the most promising and renewable energy sources that have a minimum harmful impact on the environment, as compared to other sources like fossil fuels or nuclear energy. A decade ago, research interests of the photovoltaic community have focused on hybrid organic–inorganic metal halide perovskites for photovoltaic application. Along with confirmed power conversion efficiency of 25.7%, perovskite solar cells (PSCs) show a level of performance comparable to CIGS-based cells, and are approaching the maximum efficiency of commercial monocrystalline silicon. Despite the success in boosting the efficiency of PSCs, the devices are still facing several critical challenges that hinder their commercialization e.g. low stability of perovskites under high relative humidity. In this context, developing methods to produce new lead-free perovskite systems with desirable chemical and physical properties for applications in the photovoltaic market continues to be a still challenging task.

#### Aim:

This project aims to develop a new type of 3D double perovskites (DHPs) with a structure of  $A_2TiX_6$ , which appears as promising Pb-free materials for solar cell application. Here, titanium (Ti) is in its stable  $Ti^{4+}$  oxidation state and  $Cs_2TiX_6$  is expected to possess a very high tolerance to the environmental stresses with a reported experimental tunable bandgap. This class of compounds could also be appropriate for tandem devices.  $Ti^{4+}$  is also earth-abundant, non-toxic, and biocompatible. So far, only a few investigations have been carried out with the application of  $Cs_2TiX_6$  in solar cells, due to the difficulties of synthesis from purely solution methods, where we go to solve two integrate a new technique to process it i.e., mechanosynthesized perovskites and quantum dots.

#### Requirements:

- a university degree in chemistry or materials science,
- experience in laboratory work in the field of inorganic and coordination chemistry,
- knowledge in spectroscopic methods,
- independence to design and execute experiments/characterizations, and an analytical mindset for interpreting measured data.