World′s energy demand is growing fast because of population explosion and technological advancements. It is therefore important to go for reliable, cost effective and everlasting renewable energy source for energy demand arising in future. Solar energy, among other renewable sources of energy, is a promising and freely available energy source for managing long term issues in energy crisis. Fighting climate change demands a boost in the development of renewable energies. The rapid emergence of perovskite solar cells (PSCs) as a viable new thin film photovoltaic (PV) technology has been remarkable. The unprecedented combination of high-power conversion efficiency (PCE) and potential low cost has been driving the intense PSC research endeavors worldwide. As with their analogs silicon and cadmium telluride solar cells, perovskite solar cells can convert the energy of the solar light directly into electric power with the highest efficiency. In addition to established technologies, halide perovskites are prepared from inexpensive materials, which are compatible with highly productive deposition methods. The highest certified efficiency for a single perovskite device is 25.5%, which makes halide perovskites newly discovered photovoltaic materials with the potential to provide a disruptive new solar cell technology. In addition, perovskites appear also as promising material for many efficient optoelectronic devices i.e., LEDs and memories. perovskites with the 3D structure ABX_3 (e.g., A: MA= $CH_3NH_3^+$, FA= $CH_3(NH_2)_2^+$or Cs^+, B: Pb^{2+}, X: I^- or Br^-) remain the most efficient compounds for use as solar absorbers and extensive efforts are underway to search alternative Pb-free compounds with promising properties. Unfortunately, at this moment PSCs fabricated with Pb-free perovskites exhibit limited efficiency and the development of appropriate compounds with good optical and transport properties as well as high stability is not a straightforward task that this project will face. **Searching for alternative perovskites that are Pb-free and non-toxic** is a promising research direction.

The overall goal of this project is 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 cells application. Here, titanium (Ti) is in its stable Ti^{4+} oxidation state and Cs_2TiX_6 is expected to possess very high tolerance to the environmental stresses with a reported experimental tunable bandgap, and this class of compounds could be also appropriate for tandem devices. Ti^{4+} is also earth-abundant, non-toxic, and biocompatible. So far, only 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., mechansynthesized perovskites and quantum dots.

While perovskite solar cells are revolutionizing the photovoltaic field the Pb content, and their stability are the major drawbacks for the implantation of this technology. While Sn-based perovskite solar cells are experiencing and important performance improvement in the last days, development of Ti-based perovskite solar cells will provide important clues of new materials for photovoltaic applications, key aspect for the de material science development in this field, contributing to the ultimate prediction and application of materials with lower environmental impact formed with earth abundant materials. The methodology developed for perovskite synthesis and fabrication will also benefit the chemistry and engineering of device preparation, while its characterization will be determinant to define the physical insight of a new family of photovoltaic materials. Beyond the scientific impact, and economic and technological impact is also expected. The development of efficient, safe, stable and more sustainable solar cells is extremely timely in the current context where energy consumption sources are experiencing a non-return trip to renewable energy where photovoltaic energy is call to play a key role as more abundant energy source.