Spectroscopic investigation of electronic phenomena at the lead-free perovskite/GaN interface

Since the first perovskite-based solar cell was unveiled in 2009, its efficiency has increased from 3.8% to over 25% today. However, despite the impressive pace of development of this technology, there are still many engineering aspects to its complete dissemination. One of them is the presence of lead in the chemical composition of the material absorbing solar radiation, while these materials currently show the highest efficiency. Despite this, in fear of the highly harmful influence of this element on human health and the natural environment, alternative materials are sought. One of the most promising alternatives are tin-based two-dimensional compounds as shown that this crystal geometry favorably influences the stability of the material.

On the other hand, there are also mature semiconductor materials, the combination of which with the new materials can bring fruitful results. One of them is gallium nitride (GaN), which is already widely used in LEDs and transistors.

The aim of the project is to study electronic phenomena at the 2D lead-free perovskite / GaN interface. As part of the project, $4APSnX_4$ perovskites (X = Cl, Br, I) will be synthesized directly on GaN substrates, which are designed in such a way that, using the proposed spectroscopic measurement technique, it will be possible to infer the flow of carriers between these two materials. It is very important and interesting from the point of view of semiconductor devices such as LEDs, photodetectors or solar cells, which could work on the basis of such a junction in the future. The expected result of this project is the understanding of the mechanism responsible for the carrier flow direction between the perovskite and GaN, and consequently proposing hypothetical applications in semiconductor devices.