Spectroscopy approaches to unravelling material properties across dimensionality and roles of interfaces

Jean-Christophe Blancon
Los Alamos National Laboratory, C-PCS, Los Alamos, New Mexico 87545, USA

The materials intrinsic photo-physical and electronic properties at the nano- and meso-scale can be addressed using electromagnetic fields (light radiation and electric fields) as both excitation and probes. This general principle encompasses methods for the investigation of objects, structures, interfaces, and opto-electronic devices at the microscale, as sketched in Figure 1. These studies are interesting not only from a fundamental point of view of material science but can also support the understanding and improvement of opto-electronic devices such as solar cells, light-emitting diodes, field-effect transistors, etc.

In this presentation, I will first present different spectroscopic approaches, mostly at the micro-scale, used to investigate materials properties of different dimensionality as well as the role of interfaces in optoelectronic devices. First, I will discuss the absorption properties of individual single- and double-wall carbon nanotubes. Second, the opto-electronic characteristics of both phase-engineered transition metal dichalcogenides and Ruddlesden-Popper perovskite will be examined. Finally, I will demonstrate how the macro-scale solar cell performances of large grain organic-inorganic hybrid perovskite thin films can be explained and improved via the comprehension of their microscopic intrinsic optical and electronic properties.

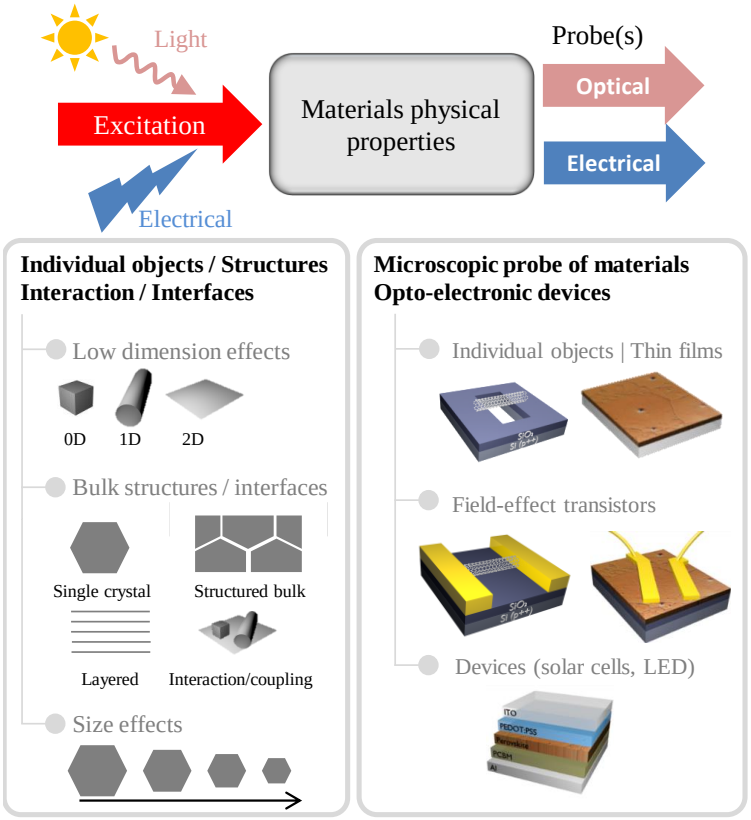

Figure 1: General principle.