Exciton-Plasmon interaction in Hybrid Transition Metal Dichalcogenide/Gold Nanostructures

Monoatomic layers of Transition Metal Dichalcogenide materials have recently triggered a strong interest due to their unique optical, electronic and spintronic properties. These properties arise from the combination of ultimate exciton confinement in two dimensions, strong spin-orbit interaction at the valence band edges and non-centrosymmetric crystal structure. Transition Metal Dichalcogenide (TMD) MX2 (where M is Mo or W and X is S, Se or Te) are very promising for applications as they might be exploited in a new class of opto-electronic devices based not only on the charge and spin degrees of freedom but also on the valley polarization induced by circularly polarized light pumping. On the other hand, surface plasmons sustained by metal nanoparticles have been extensively investigated in recent years because of their ability to capture, confine and guide light at the nanoscale and in a broad spectral range. Hence, it is very interesting to fully integrate TMD monolayers and metallic resonators within hybrid excitonic/plasmonic nanostructures with the aim of generating new optical excitations based on the near-field interaction between localized surface plasmons and confined excitons. Various applications are targeted: plasmonic enhanced sensitivity of field-effect transistors and photodetectors, enhanced photocatalytic water splitting, enhanced photoluminescence emission via direct plasmon-to-exciton conversion. In this presentation, I will discuss the physics of the plasmonic-excitonic near-field interaction in various hybrid TMD/Metal nanostructures and present recent experimental results obtained by optical spectroscopy techniques and simulations.

Biography:
Adnen Mlayah is a Professor of Physics at Paul Sabatier University of Toulouse and a researcher at the Centre d’Elaboration de Matériaux et d’Etudes Structurales-CNRS, working in the field of Nanoscience and Nanotechnology. Main research interests are centred around the optical properties of nanomaterials and nanostructures. He authored 110 research papers reporting experimental and theoretical investigations of the light-matter interaction at the nanoscale.