Optical sensing of spin-crossover compounds with 2D materials

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Abstract

The dimensionality of a system plays an important role on the properties of matter. As an example, the discovery of graphene and its outstanding properties [1] has motivated scientists to continue looking for other two-dimensional (2D) materials that could be comparable or even exhibit better and different properties for a wide range of technological applications. In this context, molecular materials have not been fully studied yet but are strong candidates to observe the proximity effects between molecular and inorganic systems at the 2D limit.

In this work, thin layers of a spin-crossover (SCO) material [2] are obtained through dry mechanical exfoliation. These systems are metal complexes of Fe(II) where the spin state of the metallic center changes between high-spin (HS) and low-spin (LS) upon application of an external stimulus (light, pressure, temperature, voltage…), showing their potential as memory devices or in spintronic applications [3]. They can be combined with inorganic 2D materials to study their synergy in different physical properties, such as their electronic or optical response. In this work, we study the optical properties using Raman spectroscopy and optical microscopy to understand how the polarization of the incident light affects the optical response of the SCO material (Figure 1.a). Moreover, we fabricate van der Waals heterostructures by combining the SCO with monolayers of WSe_2 (Figure 1.b) in order to study the interplay between them.

Our results illustrate the synergy between the SCO and the inorganic system and opens the door to explore further molecular compounds of interest whose properties cannot be detected otherwise.

REFERENCES

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[2] Martínez, V. et al., et al., Chem. Eur. J. 15, 10960-10971 (2009).
[3] Dugay, J. et al., Nano Letters 17, 186-193 (2017).

FIGURES

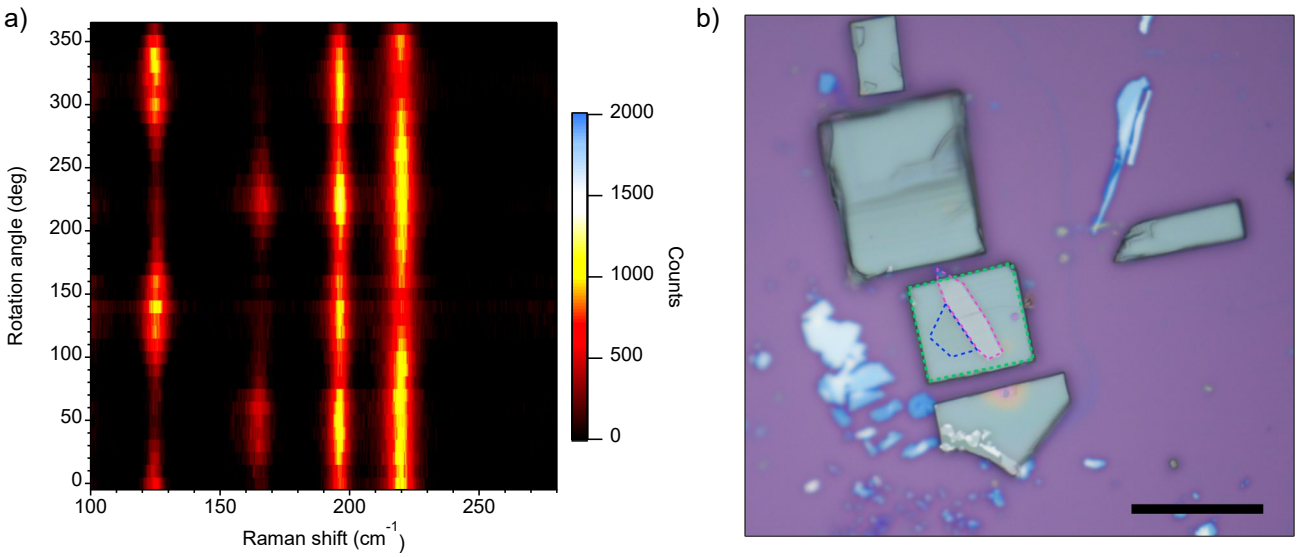

Figure 1: a) Raman spectra of the SCO as a function of the polarization of the laser. b) Optical image of a SCO/WSe_2 van der Waals heterostructure. The dashed lines correspond to the SCO (green) and the WSe_2 (the blue lines for the monolayer; the pink lines for a thicker flake). Scale bar: 20 μm.