Electronic coupling in the F4-TCNQ/single-layer GaSe heterostructure

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Hybrid heterostructures, made of organic molecules adsorbed on two-dimensional metal monochalcogenide [1], generally unveil interfacial effects that improve the electronic properties of the single constitutive layers. In this presentation, the interfacial electronic characteristics of the F4-TCNQ/single-layer GaSe heterostructure will be described [2]. Our x-ray photoemission spectroscopy results reveal that a sharp F4-TCNQ/GaSe interface has been obtained. We show that a high electron transfer from 1TL GaSe into the adsorbed F4-TCNQ molecules takes place, thereby yielding a reduction in the excess negative charge density of GaSe. Additionally, the electronic band structure of the heterostructure, obtained by means of angle-resolved photoemission spectroscopy, will be presented. Our results indicate that the buried 1TL GaSe below the F4-TCNQ layer exhibits a robust inversion of the valence dispersion at the Γ point, forming a Mexican-hat-shaped dispersion with 120 ± 10 meV of depth. Our experiments also reveal that F4-TCNQ can significantly tune the electronic properties of 1TL GaSe by shifting the band offset of about 0.16 eV toward lower binding energies with respect to the Fermi level (see Figure 1), which is a key feature for envisioning its applications in nanoelectronics.

References

[1] V. Zólyomi *et al.*, Phys. Rev. B, 87 (2013)195403.
[2] L. Khalil *et al.*, Phys. Rev. Materials, 3 (2019) 084002.

Figures

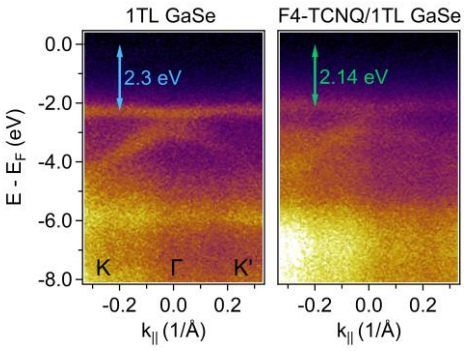

Figure 1: Comparison of the ARPES images for pristine single-TL GaSe (left panel) and the F4-TCNQ/1TL GaSe heterostructure (right panel), acquired with a photon energy of 60 eV along the GaSe ΓK- ΓK' high-symmetry direction.