ELECTRONIC AND STRUCTURAL PROPERTIES OF FERECRYSTALLINE COMPOUNDS INVESTIGATED BY PHOTOELECTRON SPECTROSCOPY

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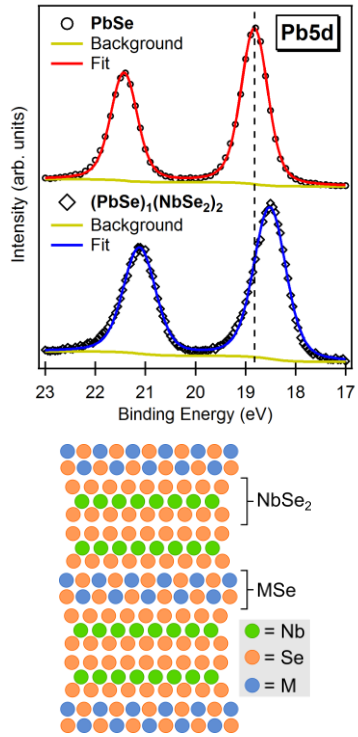

Fig. 1. ***Top:*** XPS Pb5d spectra of a $(PbSe)_1(NbSe_2)_2$ ferecrystal and binary PbSe. ***Bottom:*** Schematic representation of the structure of a $(MSe)_1(NbSe_2)_2$ ferecrystal.

The groundbreaking work on graphene by Novoselov and Geim [1] sparked a run on 2D materials. A combination of different sheet-like materials offers new possibilities in materials properties. The method of *modulated elemental reactants (MER)* [2] enables the preparation of designed turbostratically disordered intergrowths of 2D materials, termed *ferecrystals* [3].

In this work, we investigated the electronic structure of several $(MSe)_1(NbSe_2)_2$ ferecrystals using X-ray photoelectron spectroscopy (XPS). Core level and valence band spectra of ferecrystals with M = Pb or Sn were compared to their respective MER-produced binary compounds MSe and $NbSe_2$. We found evidence of inter-layer interactions and charge transfer as Pb and Sn core levels shift towards lower binding energies in the ferecrystal (Fig. 1).

With XPS, we could also confirm a decrease in the number of antiphase boundaries in $(BiSe)_1(NbSe_2)_n$, when the spacing between the BiSe layers is increased from n = 1 to 2 layers of $NbSe_2$. Antiphase boundaries are a structural modulation occurring in compounds with M = Bi, where Bi-Se bonds are periodically substituted by Bi-Bi bonds [4] (Fig. 2).

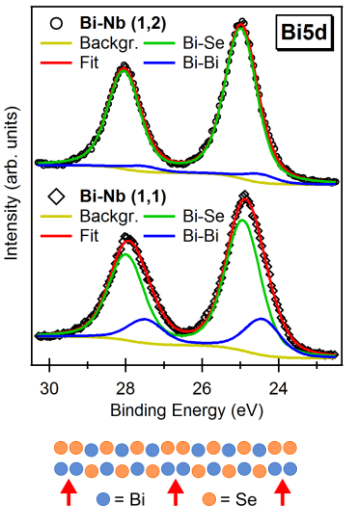

Fig. 2. XPS Bi5d spectra of two $(BiSe)_1(NbSe_2)_n$ ferecrystals with different layer stacking (short Bi-Nb (1,n)). The number of Bi-Bi bonds at antiphase boundaries (red arrows) decreases for n=2.

Keywords: Ferecrystals; Layered Compounds; XPS; Charge Transfer

References

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