Physico-Chemical nanomaterials science

The surface study of InSe(Ni) intercalate heteronanosystems

P.V. Galiy[1], P. Mazur[2], A. Ciszewski[2], T.M. Nenchuk[1], I.R. Yarovets[1], O.R. Dveriy[3], Ya.M. Buzhuk[1]

[1] *Electronics and Computer Technology Department, Ivan Franko Lviv National University, 50 Dragomanov Street, Lviv, 79005, Ukraine*.
E-mail: galiy@electronics.lnu.edu.ua

[2] *Institute of Experimental Physics, University of Wrocław, pl. Maxa Borna 9, 50-204 Wrocław, Poland*.

[3] *Chair of Electromechanics and Electronics, National Academy of Land Forces, 32 Geroiv Majdanu Street, Lviv, 79012, Ukraine*

InSe(Ni) intercalate nanosystem have a potential to be applied for designing various functional devices in magnetoelectronics. The valuable nanoscale properties of such hybrid metal-semiconductor system are due to the relatively easy way of its obtaining as self assembling system. Ni intercalates into the low-dimensional InSe crystal while growing by Bridgman - Stockbarger method from previously synthesized melts InSe + up to 10 at. % of Ni.

The surface of such obtained structures is an interesting object of study itself and might be just get by cleavage even in UHV. The scanning tunneling microscopy/spectroscopy (STM/STS) studies in addition to the only surface properties provide an opportunity to consider what is in the bulk of crystal because we physically examine the contents of the interlayer gap.

STM/STS data were obtained by Omicron Nano Technology STM/AFM System operating with UHV better than 10^{-10} Torr. Since the STM image is actually a reflection of surface density of states at local points on the surface and probe tungsten tip one convolution, their analysis, especially in STS mode enables to distinguish between semiconducting and metallic nature of localized areas on nanoscale. Such detailed study is possible with application of current imaging tunneling spectroscopy (CITS) analysis. The last one allows to obtain matrix of experimental data, including I-V curves discretized over bias voltage which are associated with local points (≅1Å) of analysis on the surface (6400 points). Thus, STS analysis shows that cleavage surface is covered by Ni clusters ≅1% against of all explored points on the nanoscale. Our previous X-ray photoelectron spectroscopy and low electron energy diffraction studies suggest that in fact we are dealing with nickel phase that is ordered at the micro level, but it's not uniform at the nanoscale.