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Ткач В.А. молодший науковий співробітник, відділ №47 Спектроскопії поверхні новітніх матеріалів
Науковий керівник: Хижун О.Ю., с.н.с., д.ф.-м.н., голова відділу №47 Спектроскопії поверхні новітніх матеріалів
(Інститут проблем матеріалознавства ім.І.М.Францевича НАН України, м.Київ, Україна)

ELECTRONIC STRUCTURE OF $Tl_2CdSnSe_4$ COMPOUND STUDIED BY XPS METHOD

Quaternary chalcogenide semiconductors with general chemical composition I_2–II–IV–Q_4 (I – Cu, Ag; II–Zn, Cd, Hg; IV–Si, Ge, Sn; Q–S, Se, Te) became a point of great interest of many material scientists due to their great combination of physical and chemical properties. Band gap width, p-type conductivity, thermoelectrical and optical properties make these compounds as promising materials for solar energy conversion applications or nonlinear optic devices.

Thallium-based quaternary chalcogenides are less known and studied that Cu- or Ag-based quaternary compounds. But it is known that Tl^+ ions can substitute copper/silver atoms in diamond-like phases, so it is interesting and important to investigate properties of Th-based quaternary chalcogenides.

Quaternary $Tl_2CdSnSe_4$ selenide is a typical member of the family of I2–II–IV–Q4 chalcogenides crystallizing generally in LT-modification tetragonal (space group (SG) $I\bar{4}2m$) structure which belong to stannite and wurzite type.

For the better understanding of the properties of chalcogenides compounds measurements of electronic structure of $Tl_2CdSnSe_4$ were made by X-ray photoelectronic spectroscopy method. Influence of Ar+ ion surface treatment on stability of the surface layers of $Tl_2CdSnSe_4$ monocrystal was also investigated.

Table 1. [1]

Binding energy values measured in eV for core level electrons of as synthesized and treated with the Ar+ ions surfaces of the $Tl_2CdSnSe_4$ crystal

Core-level	$Tl_2CdSnSe_4$	$Tl_2CdSnSe_4$ with Ar+ ion surface treatment
Tl $5d_{5/2}$	12.29	12.34
Tl $5d_{3/2}$	14.44	14.47
Sn 4d	25.09	25.02
Se 3d	53.26	53.33
Tl $4f_{7/2}$	117.43	117.54
Tl $4f_{5/2}$	121.86	121.99
Tl $4d_{5/2}$	384.62	384.74
Cd $3d_{5/2}$	404.85	404.91
Cd $3d_{3/2}$	411.53	411.60
Sn $3d_{5/2}$	485.45	485.37
Sn $3d_{3/2}$	493.93	493.84

Results of XPS measurements $Tl_2CdSnSe_4$ crystal without and with Ar+ ion treatment are shown in table 1. Data shows that Ar+ ion treatment does not case a great influence on binding energy values of main core levels of Tl, Sn, Cd, and Se. Also Ar+ ion treatment fully

remove hydrocarbon-bearing and oxygen-containing adsorbates from the surface of crystal (fig.1). It means that $Tl_2CdSnSe_4$ crystal surface has a low hygroscopicity, which can be important for using at the ambient conditions.

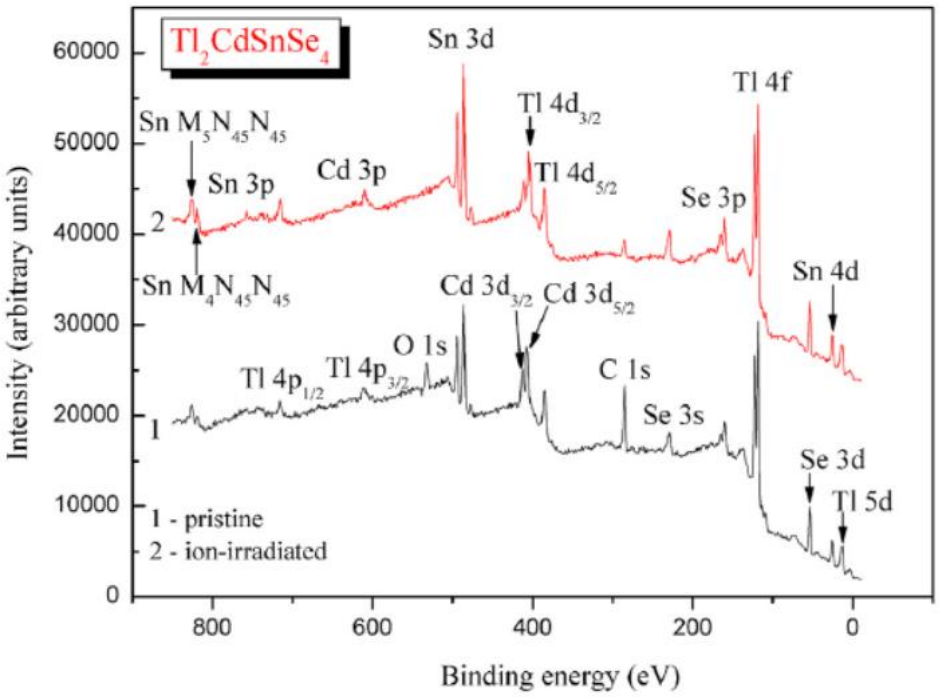

Figure 1 – Wide XP spectra measured for (1) as synthesized and (2) treated with the Ar+ ions surface of the $Tl_2CdSnSe_4$ crystal. [1]

Following the composition of the Tl2CdSnSe4 crystal and accounting for requirements of the charge balance in it, it could expected that the nominal valences of the constituting chemical elements as following: Tl^{1+}, Cd^{2+}, Sn^{4+}, and Se^{2-}. But XPS data shows that additionally to ionic constituent there is a significant covalent interatomic bond between M – Se (where M = Cd, Sn) atoms.

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Чечель Т.О., асистент кафедри механічної та біомедичної інженерії, аспірант кафедри біомедичної інженерії
(*Національний технічний університет «Дніпровська політехніка», м. Дніпро, Україна)*
Науковий керівник: Носова Т.В., к.т.н., доцент кафедри біомедичної інженерії
(Харківський національний університет радіоелектроніки, м. Харків, Україна)

АНАЛІЗ МЕТОДА ЕНДОПРОТЕЗУВАННЯ СУГЛОБІВ КИСТІ

Кисть людини – це орган складної анатомічної будови, тонкої фізіологічної функції та координованих рухів. Як одна з найбільш функціонально навантажених