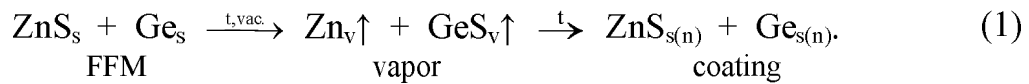


## CVD-Composites as Perspective Film-Forming Materials

Zinchenko V.F.

*A.V. Bogatsky Physico-Chemical Institute of NAS of Ukraine, Odessa, Ukraine*

Film-forming materials (FFM) are used as initial substances for obtaining coatings by so-called PVD (Physical Vapor Deposition) method more often. In a CVD (Chemical Vapor Deposition) method the coating is formed in a course of gaseous reactions between volatile components. Earlier [1] it is developed composite FFM on the basis of system ZnS-Ge, evaporating congruently at rather low temperatures. We [2] represent the evaporation mechanism in vacuum and condensation on a substrate of this material. It combines features both PVD, and CVD processes:



The calculated value of conditional temperature ( $T_a = T_{P \approx 1.33 \text{ Pa}}$ ) is  $590^\circ\text{C}$  for a composite that is much lower, than for ZnS ( $820^\circ\text{C}$ ). Thus, according to XRDA (fig.), the nano-composite type coating occurs though the initial material being microcrystalline.

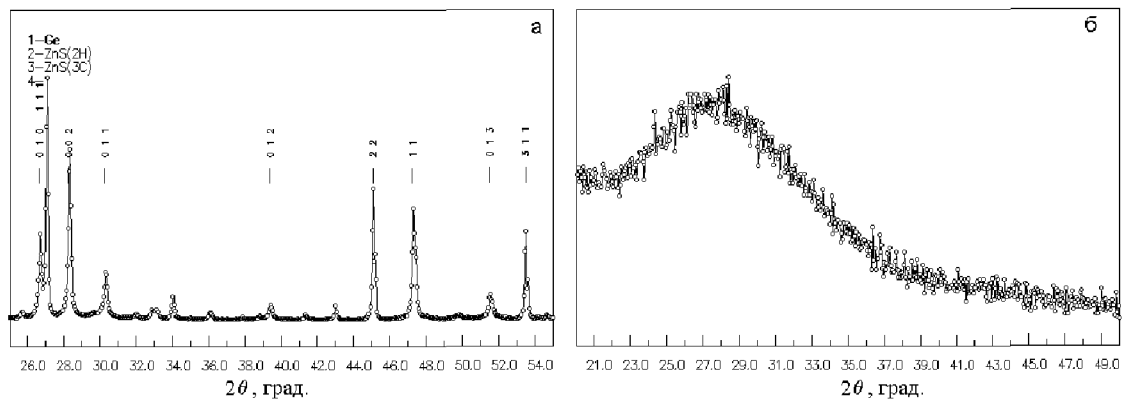
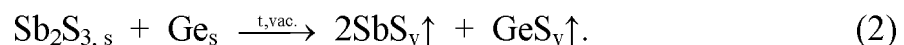


Fig. X-ray diffractograms of the initial CVD-composite ZnS-Ge (a) and the coating produced from it (b).

It makes possible to improve essentially optical and operational (especially, mechanical durability) parameters of coatings (tab.) and to expand domain of transparency of Ge up to border of a visible range of a spectrum.

The materials evaporating and condensed in a similar way are named CVD-composites. In addition to their application as FFM of new type, they are used, for example, in a finishing stage of a way of deep clearing of zinc sulfide from oxide admixture [2]. In it surplus of the sulfidizing agent,  $\text{Sb}_2\text{S}_3$  is eliminated by processing by an additive disperse Ge under the scheme:



Sb<sub>2</sub>S<sub>3</sub>-Ge composite makes it possible obtaining coatings with much higher mechanical durability in comparison with a coating produced from pure Sb<sub>2</sub>S<sub>3</sub>.

Table

Some CVD-composites and parameters of thin-film optical coatings

Composition	Patent of Ukraine, No	Development (year)	Parameters of coatings		
			Refractive index, n	Scattering factor, %	Mechanical durability, rotations/group
ZnSe-Ge	75529	2012	3.30	0.05	10000/0
Sb <sub>2</sub> S <sub>3</sub> -Ge	81076	2013	3.10	0.02	4500/0
Sb <sub>2</sub> Se <sub>3</sub> -Ge	87624	2014	3.66	–	7000/0
In <sub>2</sub> Se <sub>3</sub> -Ge	92947	2014	3.45	–	8000/0

Other CVD-composites as FFM on the basis of binary compounds are investigated also, namely: ZnSe-Ge, Sb<sub>2</sub>Se<sub>3</sub>-Ge, In<sub>2</sub>Se<sub>3</sub>-Ge, EuS-Ge, EuSe-Ge, ZnO-Ge, GeO<sub>2</sub>-Ge, SnO<sub>2</sub>-Ge, etc. [3]. Their considerable part has shown also high level of optical and operational parameters of coatings (tab.). Further as one of components of CVD-composites complex chalcogenides of chalcospinel MM'<sub>2</sub>X<sub>4</sub> (M–Mn, Zn, Eu(II), Yb(II), M'–In, Yb(III), X–S, Se) type are applied. The fact of partial interaction of more volatile component of complex chalcogenide with Ge as a part of a CVD-composite is established. It affects both on process of evaporation of composites, and on parameters of obtained coatings.

It is supposed to expand circle of FFMs of CVD-composite type, using as one of components complex oxide that allows to hope that it will be possible to deposit in a soft technological mode nano-composite coatings with electro-conductive properties.

1. Zinchenko V.F., Kocherba G.I., Magunov I.R., Mozkova O.V., Sobol V.P., Belayavina N.M. Optical properties of the thin-film coatings obtained from the ZnS-Ge composites by CVD // Phys. Chem. Solid State.-2011.-V.12, No2.-P. 433-437.
2. Zinchenko V.F., Chygrynov V.E., Mozkova O.V., Magunov I.R., Kovalevska I.P. Effect of interaction in system ZnS(ZnO)-Sb<sub>2</sub>S<sub>3</sub>-Ge on parameters of the produced thin films // Phys. Chem. Solid State.-2014.-V.15, No3.-P.579-583.
3. Zinchenko V.F., Chygrynov V.E., Mozkova O.V., Magunov I.R., Sadkovska L.V. Influence of interaction on optical properties of composites of GeO-GeO<sub>2</sub> and Ge-GeO<sub>2</sub>(SnO<sub>2</sub>) systems // Ukr. Khim. Zhurn.-2013.-V.79, No10.-P.91-95.