

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

ДВНЗ «Прикарпатський національний університет імені Василя Стефаника»

Кафедра фізики і хімії твердого тіла

Фізико-хімічний інститут

Навчально-дослідний центр напівпровідникового матеріалознавства

АКАДЕМІЯ НАУК ВИЩОЇ ШКОЛИ УКРАЇНИ

НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ

Інститут фізики напівпровідників ім. В.Є. Лашкарьова

Інститут хімії поверхні ім. О.О. Чуйка

Інститут металофізики ім. Г.В. Курдюмова

Інститут загальної і неорганічної хімії ім. В.І. Вернадського

Українське фізичне товариство

Інститут інноваційних досліджень (Івано-Франківськ, Україна)

Університет Цзілінь (Чанчунь, Китай)

**XVII МІЖНАРОДНА ФРЕЙКІВСЬКА КОНФЕРЕНЦІЯ З ФІЗИКИ І
ТЕХНОЛОГІЇ ТОНКИХ ПЛІВОК ТА НАНОСИСТЕМ**

Збірник тез

Івано-Франківськ, 20-25 травня, 2019

Ivano-Frankivsk, May 20-25, 2019

Abstract book

**XVII INTERNATIONAL FREIK CONFERENCE ON PHYSICS AND
TECHNOLOGY OF THIN FILMS AND NANOSYSTEMS**

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

Vasyl Stefanyk Precarpathian National University

Physics and Chemistry of Solids Department

Physical-Chemical Institute

Educational Research Centre for Semiconductor Material

ACADEMY OF SCIENCE OF HIGH SCHOOL OF UKRAINE

NATIONAL ACADEMY OF SCIENCE OF UKRAINE

V.E. Lashkarev Institute of Semiconductor Physics

Chuiko Institute of Surface Chemistry

G.V. Kurdyumov Institute of the Physics of Metals

V.I. Vernadsky Institute of General and Inorganic Chemistry

Ukraine Physics Society

Institute of Innovation Research (Ivano-Frankivsk, Ukraine)

Jilin University (Changchun, P. R. China)

Defect Formation in the Tin Telluride Thin Films at their Growth from a Vapour Phase

Prokopiv V.V.¹, Turovska L.V.², Nykyruy L.I.¹, Dzundza B.S.¹

¹Vasyl Stefanyk Prearpathian National University, Ivano-Frankivsk, Ukraine, prkvv@i.ua

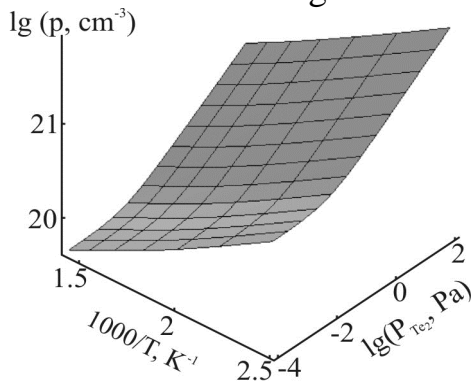
²Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine

The main factor determining the performance of the device structures is defect subsystem of crystal structure of the base material, which in turn is determined by technological factors of growing process.

The thin films have been grown from the vapour phase by the hot-wall epitaxy method on monocrystalline BaF₂ (111) substrates. The defect subsystem of the material has been studied using modelling method via quasichemical reactions. The values of the equilibrium constants for quasichemical reactions of defect formation in SnTe have been calculated theoretically. The constant $K_{Te_2,V}$ of the reaction of formation of neutral defects $\frac{1}{2} Te_2^V = V_{Sn}^0 + Te_{Te}^0$ has been found by the method of thermodynamic potentials; constants K_a , K'_a for reactions of ionization of formed defects $V_{Sn}^0 = V_{Sn}^- + h^+$, $V_{Sn}^0 = V_{Sn}^{2-} + 2h^+$ and the constant K_i for the reaction of excitation of intrinsic conductivity $0 = e^- + h^+$ have been calculated using the band theory of non-degenerate semiconductors.

Analytical expressions for determination of Hall concentration p_H , concentrations of electrons n and singly and doubly charged tin vacancies $[V_{Sn}^-]$, $[V_{Sn}^{2-}]$ have been obtained: $p_H = p - K_i / p$; $n = K_i / p$; $[V_{Sn}^-] = K_a K_{Te_2,V} P_{Te_2}^{1/2} \cdot p^{-1}$; $[V_{Sn}^{2-}] = K'_a K_{Te_2,V} P_{Te_2}^{1/2} \cdot p^{-2}$. The hole concentration p is defined by the cubic equation: $p^3 - (K_a K_{Te_2,V} P_{Te_2}^{1/2} + K_i)p - 2K'_a K_{Te_2,V} P_{Te_2}^{1/2} = 0$.

Based on the obtained ratios, the dependences of the concentrations of charge carriers and point defects in tin telluride thin films on substrate temperature T_S , evaporation temperature T_E and partial vapour pressure of tellurium P_{Te_2} have been calculated. It has been shown that in SnTe films, concentration of charge carriers is determined by singly charged tin vacancies.



3d-Diagram of the dependence of hole concentration in tin telluride films on partial vapour pressure of tellurium P_{Te_2} of additional source and the substrate temperature T_S at evaporation temperature $T_E = 800$ K