

PACS 61.43.Fs, 61.80.Ed, 78.20.-e

**Comments on the “Metallic nanoparticles (Cu, Ag, Au) in chalcogenide and oxide glassy matrices: comparative assessment in terms of chemical bonding”** // *Semiconductor Physics, Quantum Electronics & Optoelectronics*, **20**(1), p. 26-33 (2017).

**T.S. Kavetsky<sup>1,2</sup>, A.L. Stepanov<sup>3,4</sup>**

<sup>1</sup>*Drohobych Ivan Franko State Pedagogical University,  
24 I. Franko Str., 82100 Drohobych, Ukraine*

<sup>2</sup>*The John Paul II Catholic University of Lublin, 14 Al. Raclawickie, 20-950 Lublin, Poland*

<sup>3</sup>*Kazan Physical-Technical Institute, Russian Academy of Sciences,  
10/7 Sibirskiy trakt, 420029 Kazan, Russian Federation*

<sup>4</sup>*Kazan Federal University, 18 Kremlevskaya Str., 420008 Kazan, Russian Federation*

Recently, in the work [1], restricted information collected from our references [2-4] was used for speculative and wrong conclusions based on this incorrectness and published for understanding the metal nanoparticles (MNPs) formation in chalcogenide and oxide glassy matrices. In particular, the authors of this work [1] have made some misleading opinions on the some statements which are not presented in our cited papers. First of all, the statement mentioned in the work [1] “...They asserted that Cu MNPs could be gathered in spherical entities of only 5 to 10 nm in radius, giving essential changes in optical linear absorption at the wavelengths 580...590 nm and response in nonlinear optical properties observed in Z-scan measurements...” has been not reported in the publications [2-4]. If some opinion regarding the size of ion-synthesized Cu nanoparticles in chalcogenide glasses was noted by the authors [2-4] in other publications (e.g., abstracts or conference materials), it could be only as assumption but not as assertion. In order to make such assertion on the size of MNPs as in our case, the optical linear absorption data are not enough. Therefore, our experiments with ion-implanted chalcogenide glasses are currently in progress to get more microscopy information.

Besides, a comparison of 40 keV Cu<sup>+</sup>-ion implantation into chalcogenide glasses [2-4] with a penetration of implanted ions in the near-surface region only up to 60 nm (from SRIM – The Stopping and Range of Ions in Matter simulation) with higher energy 70 keV [5] and 200 keV [6,7] Ag<sup>+</sup>-ion implantation into chalcogenide glasses, allowing a deeper penetration of implanted ions into the bulk of material, has also been incorrectly performed in the work [1]. From these reasons, a comparative assessment made by the authors [1] in terms of chemical bonding for metal nanoparticles formation in glassy and oxide matrices, when the penetration depth of implanted ions is fully ignored, is obviously absolutely wrong and inconclusive. Moreover, it is not a case of near-surface effects created by low-energy (30-40 keV) ion implantation [2-4, 8-10], especially for chalcogenides for which a polishing procedure may have uncontrolled impact on the homogeneous structure of glass in the near-surface region.

*References*

1. O.I. Shpotyuk, M.M. Vakiv, M.V. Shpotyuk, S.A. Kozyukhin, Metallic nanoparticles (Cu, Ag, Au) in chalcogenide and oxide glassy matrices: comparative assessment in terms of chemical bonding // *Semiconductor Physics, Quantum Electronics & Optoelectronics*, **20**(1), p. 26-33 (2017).
2. T.S. Kavetsky, V.F. Valeev, V.I. Nuzhdin, V.M. Tsmots, A.L. Stepanov, Optical properties of chalcogenide glasses with ion-synthesized copper nanoparticles // *Tech. Phys. Lett.*, **39**(1), p. 1-4 (2013).

3. T. Kavetsky, A.L. Stepanov, V.V. Bazarov, V. Tsmots, J. Ren, G. Chen, X. Zhao, Comparative study of optical properties of polarizing oxide glasses with silver nanorods and chalcogenide glasses with copper nanoparticles // *Phys. Procedia*, **48**, p. 191-195 (2013).
4. T.S. Kavetsky, A.L. Stepanov, Effects of gamma-irradiation and ion implantation in chalcogenide glasses. Chapter 14 // In: *Glass Nanocomposites: Synthesis, Properties and Applications* (B. Karmakar, K. Rademann, A.L. Stepanov, eds.), Elsevier Academic Press, 2016, p. 341-358.
5. M. Song, Q.M. Liu, G. Xu Cai, F. Ren, Enhancement of third-order optical nonlinearities in 72GeS<sub>2</sub>-18Ga<sub>2</sub>S<sub>3</sub>-10CdS glasses by Ag ion implantation // *Chalcogenide Lett.*, **12**(9), p. 453-460 (2015).
6. Q. Liu, X. He, X. Zhao, F. Ren, X. Xiao, C. Jiang, H. Zhou, X. Zhao, L. Lu, S. Qian, Third-order nonlinearity in Ag-nanoparticles embedded 56GeS<sub>2</sub>-24Ga<sub>2</sub>S<sub>3</sub>-20KBr chalcogenide glasses // *J. Non-Cryst. Solids*, **357**, p. 2320-2323 (2011).
7. Q. Liu, X. He, X. Zhao, F. Ren, X. Xiao, C. Jiang, X. Zhou, L. Lu, H. Zhou, S. Qian, B. Poumellec, M. Lancry, Enhancement of third-order nonlinearity in Ag-nanoparticles-contained chalcogenide glasses // *J. Nanopart. Res.*, **13**, p. 3693-3697 (2011).
8. A.L. Stepanov, E.A. Evlyukhin, V.I. Nuzhdin, V.F. Valeev, Y.N. Osin, A.B. Evlyukhin, R. Kiyani, T.S. Kavetsky, B.N. Chichkov, Synthesis of periodic plasmonic microstructures with copper nanoparticles in silica glass by low-energy ion implantation // *Appl. Phys. A: Mater. Sci. Process.*, **111**, p. 261-264 (2013).
9. T.S. Kavetsky, M.F. Galyautdinov, V.F. Valeev, V.I. Nuzhdin, Yu.N. Osin, A.B. Evlyukhin, A.L. Stepanov, The formation of periodic diffractive plasmonic nanostructures with implanted copper nanoparticles by local ion etching of silica glass // *Tech. Phys. Lett.*, **39**(7), p. 591-593 (2013).
10. T.S. Kavetsky, V.I. Nuzhdin, V.F. Valeev, Y.N. Osin, A.L. Stepanov, Optical properties of the synthesized ZnO with ion implanted silver nanoparticles // *Tech. Phys. Lett.*, **41**(6), p. 537-539 (2015).