

INFLUENCE OF EXTERNAL NUCLEATION CENTERS IN THE SOLVOTHERMAL SYNTHESIS OF SILVER NANOWIRES

Mihai-Cosmin Pascariu, Daniel Ursu, Cristina Mosoarca, Radu Banica

*National Institute of R&D for Electrochemistry and Condensed Matter,
144 Dr. Aurel Păunescu-Podeanu, RO-300569 Timisoara, Romania
e-mail: mihai.cosmin.pascariu@gmail.com*

Abstract

The influence of external heterogeneous crystallization active centers, such as nucleation centers on the glass surface, porous SiO₂, and activated carbon, on the growth of silver nanowires [1] is a topic still in its infancy. For this reason, in this study, silver nanowires were synthesized in a microwave field, in the presence of external nucleation seeds other than AgCl, in order to observe the influence of temperature increase on the morphology of crystals obtained on various substrates in a pressurized reactor. The SynthWAVE 3000 microwave reactor was used to obtain metal nanocrystals with varied shape factors. SCS glass spheres, silica gel and activated carbon, were impregnated with the reaction mixture. The samples were placed in the reactor, pressurized to approx. 26 bar at 20 °C, heated to 160 °C, separated by filtration or centrifugation and washed with ethanol, after which the impregnated ones were dried in an oven and the others were kept in suspension.

The samples were morphologically characterized by scanning electron microscopy (Figure 1).

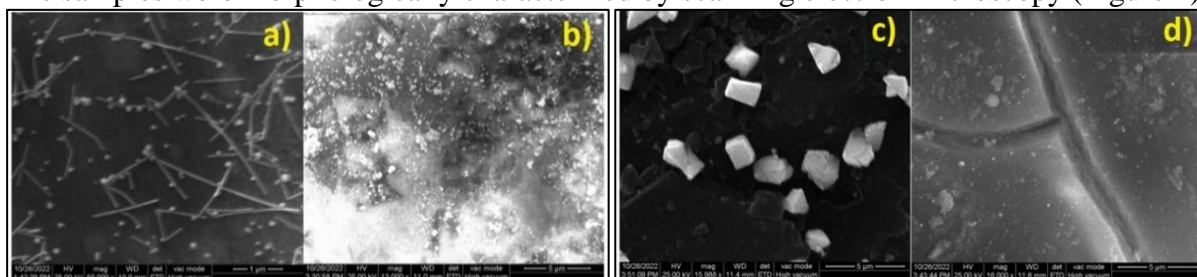


Figure 1. SEM images of microwave-grown silver nanowires (a) without substrate, (b) on the surface of glass spheres, (c) on the surface of activated carbon, and (d) in silica gel matrix

The existence of external nucleation centers, other than AgCl, causes the crystallization of the metal in completely different morphologies. In their absence, a mixture of metal nanoparticles and nanowires, with thicknesses generally less than 100 nm and lengths of several micrometers, is formed. Silver nanoparticles of quasi-spherical shape and very small sizes are also formed in the case of glass spheres and silica gel, while when using activated carbon, silver microparticles are formed very uniformly distributed on the surface of the support. This shows that inorganic substrates represent heterogeneous nucleation centers, strongly competing with AgCl nanocrystals, while activated carbon, although it has a higher specific surface area, does not show a high density of nucleation centers for the metal.

Acknowledgements

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI-UEFISCDI, project number PN-III-P2-2.1-PED-2021-2541, within PNCDI III.

References

[1] D. Ursu, R. Banica, M. Vajda, C.B. Baneasa, M. Miclau, J. Alloys Compd. 902 (2022) 163890.