

Metal deposited nanoparticles as "bridge materials" for lead-free solder nanocomposites WIEN

A. Yakymovych¹, Yu. Plevachuk², P. Švec Sr³, P. Švec^{3,4}

¹Institute of Chemical Technologies and Analytics, TU Wien, Vienna, Austria

² Department of Metal Physics, Ivan Franko National University of Lviv, Lviv, Ukraine

³ Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovakia

⁴ Centre of Excellence for Advanced Materials Application, Slovak Academy of Sciences, Bratislava, Slovakia

E-mail: andriy.yakymovych@tuwien.ac.at

Background and motivation

- increasingly lead-free solder (LFS) application in various industries requires further improvement of their properties.
- the exceptional mechanical and physical properties demonstrated by carbon nanotubes (CNTs) combined with their low density, has made this new form of carbon an excellent candidate for composite reinforcement.

Experimental

- Ternary Sn96.5Ag3Cu0.5 (wt.%) (SAC305) was taken as the basic alloy. Multi-walled CNTs with the diameter of approx. 15-20 nm were obtained
- by the catalytic chemical vapor deposition method (CCVD). The bulk density of CNTs was within 20-40 g/dm3, which is 3 orders of magnitude smaller than the density of the CNT wall (about 2.2 g/cm3).
- CNT were coated by Au and Ni nanoparticles. The conventional DC Diode Sputter Coater Bio-Rad E5400 was used.



Carbon nanotubes (TEM)



Au-coated carbon nanotubes (TEM)



Au-coated TiO2 nano powder (TEM)

This study was supported by Slovak Grant Agencies under Project Nos. APVV-15-0621, VEGA 2/0082/17 and 2/0135/19, project RK_0122U002643 of Ministry of Education and Science of Ukraine and by Austrian Science Fund (FWF) under Project No. P 34894.



Shear strength and microhardness



Scheme of the Cu/solder/Cu joint



Reflow temperature profile of solder-Cu joint

The shear strength of the joints was measured by a push-off method (Zwick/Roell Z 100) employing a loading rate 1.10⁻³ m·min⁻¹. The microhardness tests were performed using a Microhardness Tester FM-100





The average thickness of the Cu₆Sn₅ and Cu₃Sn layers at the interface (SAC305+Au-coated CNs)/Cu





onvention

Bureau



