ABSTRACT BOOK

International research and practice conference:

NANOTECHNOLOGY AND NANOMATERIALS (NANO-2022)

25-27 August 2022
Lviv, Ukraine

INTERNATIONAL RESEARCH AND PRACTICE CONFERENCE "NANOTECHNOLOGY AND NANOMATERIALS"

(The NANO-2022 Conference is dedicated to the International Year of Basic Sciences for Sustainable Development)

25-27 of August 2022

Lviv, UKRAINE

Abstract book

Insights into synthesis of nanosized Ni and Fe particles by chemical reduction method

Wodak I.[1], Yakymovych A.[1], Khatibi G.[1,2]

[1] Institute of Chemical Technologies and Analytics, TU Wien, Vienna 1060, Austria

[2] Christian Doppler Laboratory for Lifetime and Reliability of Interfaces in Complex Multi-Material Electronics, TU Wien, Vienna 1060, Austria
E-mail: andriy.yakymovych @tuwien.ac.at

The synthesis of metal nanoparticles (NPs) by chemical reduction involves the reduction of metal ions of an inorganic soluble metal salt with a reducing agent [1]. This is the most common method to produce metal NPs due to its simple and reliable procedure.

In this study, two procedures have been used to produce Fe and Ni NPs. According to the first procedure, the reduction of the metal salt by hydrazine hydrate in an aqueous solution, while sodium hydroxide has been used as a stabilizing solvent as well as polyvinylpyrrolidone as a surface stabilizer and as a protective agent. A similar method has been used in our previous study [2]. The second procedure is the so-called polyol chemical reduction using ethylene glycol as a reduction agent, while chloroplatinic acid has been used as a heterogeneous nucleating agent.

The powder X-ray diffraction has been employed to determine the phases presented in the nano-sized metal powder. The scanning transmission electron microscopy (STEM) has provided images from which the shape, size, and size distribution of the produced nanoparticles have been determined.

Financial support for this study came from the Austrian Science Fund (FWF) under Project No. P 34894.

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2. Yakymovych A, Ipser H. Synthesis and characterization of pure Ni and Ni-Sn intermetallic nanoparticles // Nanoscale Res Lett.-2017.-12.-142. doi: 10.1186/s11671-017-1894-2.

Metal deposited nanoparticles as “bridge materials” for lead-free solder nanocomposites

***Yakymovych A.*[1], Plevachuk Yu.[2], Švec Sr P.[3], Švec P.[3,4], Sklyarchuk V.[2]**

[1]*Institute 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: yuriy.plevachuk@lnu.edu.ua

It is known that additions of metal or ceramic nanoparticles, as well as carbon nanotubes (CNTs) to the basic Sn-Ag-Cu matrix can improve significantly creep resistance and other important mechanical properties of lead-free solders as well as significantly decrease the total intermetallic thickness of solder-substrate joints.

In case of CNTs, it should be taken into account that practically all types of CNTs are completely not wettable by liquid metal alloys. This is the main reason that that inhibits the interaction betwen CNTs and the solder melt during the reflow process. In the course of soldering, most of carbides, oxides, and carbon-based ceramics can be pushed out of the molten solder during the reflowing process connected with the nonwettability, which is due to differences between some thermophysical properties such as, first of all, density and surface tension. To solve this problem, the surfaces of these carbon materials can be modified by the secondary metal phases to improve adoption with the solder matrixes before implementation.

The carbon nanotubes were added to the basic ternary metal Sn-Ag-Cu matrix. The conventional DC Diode Sputter Coater was used for the purpose of coating of CNTs by Ni and Co. Sputtered nanosized Ni and Co layers covered the surface of used nanoparticles, enhancing their uniform distribution in the matrix of the solder and forming a “bridge” substance, which reacts with the matrix of the SAC alloy and forms the layer of the intermetallic compounds in the course of the soldering procedure. The influence of different pure CNTs and CNTs coated by metals on structure and structure-sensitive properties of the Sn-Ag-Cu nanocomposite alloys was evaluated.

Support of the projects APVV-SK-UA-21-0076, VEGA 2/0144/21, UA-SK Project No. M/68-2022 and the FWF Project P 34894 is gratefully acknowledged.

Hybrid solder joints: the effect of nano-sized Ni and ceramic admixtures on morphology and shear strength of Sn-5.0Ag solder joints

Wodak I.[1], Yakymovych A.[1], Strutz P.[1], Wimmer C.[1], Yerbol S.1, Khatibi G.[1,2]

[1] Institute of Chemical Technologies and Analytics, TU Wien, Vienna 1060, Austria

[2] Christian Doppler Laboratory for Lifetime and Reliability of Interfaces in Complex Multi-Material Electronics, TU Wien, Vienna 1060, Austria
E-mail: andriy.yakymovych@tuwien.ac.at

The concept of hybrid solder joints is a promising approach to improve the mechanical reliability of lead-free solder joints. For instance, the mechanical reliability of such solder/Cu joints has been improved by minor additions of nano-sized particles, while the morphology of the solder joints has been also enhanced [1].

The present research is the follow-up of our previous study of the hybrid Sn-3.0Ag-0.5Cu (SAC305) solder joints [2]. Furthermore, we have synthesized Ni nanoparticles (NPs) by the chemical reduction method. The Sn-5.0Ag foil has been used in this study to produce the solder joints, while the Ni NPs have been mixed into the commercial flux. As an alternative, the TiO_2 and ZrO_2 NPs have been used to produce the hybrid Sn-0.5Ag/Cu solder joints.

According to the SEM analysis, the morphology at the interface solder/Cu has been enhanced by the addition of nano-sized inclusions. The shear strength of the hybrid solder joints has been also improved compared to the undoped joint. The experimental results have been compared with the literature.

Financial support for this study came from the Austrian Science Fund (FWF) under Project No. P 34894.

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2. Aspalter A., Cerny A., Goeschl M., et al. Nanocomposite solder joints: morphology and mechanical properties of Sn-3.0Ag-0.5Cu solder joints by adding ceramic nanoparticles through flux doping // Appl Nanosci.-2020.-10.-4943-4949.