Lead-Free Solders

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The ecological agencies have begun sounding the alert to stop the accumulation of "poisonous" electronic scrap, by introducing new lead-free materials for soldering, plus legal regulations to ban the use of lead-bearing materials

Two elements can be bonded together by introducing a small amount of molten metal between them. After it solidifies the metal creates a solid connection, and this technique is called "soldering." The quality and reliability of such joints depends on many factors, but the features of the material used to make the joint - the "solder" - are of great importance. Soldering is now mainly employed in the electronics industry, one of the most important sectors of the world economy. The most universal and the best solder material currently in use is an alloy of lead and tin.

Various electronic devices play an increasingly important role in our everyday life: audio-visual and household equipment, telecommunications gear, cars and airplanes - all of them containing lead-bearing electronic circuits. The lifetime of such devices is limited, and electronic trash sooner or later ends up in legal or illegal waste depots. Corrosion processes cause poisonous lead compounds to penetrate the soil and underground water, leading to the contamination and devastation of the environment.

As a result, an intensive search to find replacement materials began in the early 1990s in the "electronic giants," the US and Japan, leaving Europe behind. Europe awoke in 2001, when Professors Ipser and Mikula, scientists from Vienna University, initiated the "COST 531 Lead-free Solder Materials" action, with the aim of identifying new lead-free solder materials. The initiators invited about 40 experts from 13 European countries, to take part in the campaign. There were 5 Polish experts in this group, 4 of them from the Kraków-based Institute of Metallurgy and Materials Science (IMMS) of the Polish Academy of Sciences.

There are three research groups in this scientific unit, dealing with the topic of lead-free solders: • A team led by Dr. W. Gąsior investigates the physicochemical properties of fluids in order to identify potential new solder materials. • Professor P. Zięba's team studies the quality of the resulting joint in diffusion soldering processes. • Professor L. Zabdyr's group researches the thermodynamic properties and phase diagram calculations of silver-based alloy systems. In order to support the implementation of environment-friendly materials and technologies in Poland, an "Environment-Friendly Materials and Technologies - LEFSOL" Competence Center has emerged as a consortium of nine leading Polish R&D institutions, coordinated by the IMMS in Kraków.

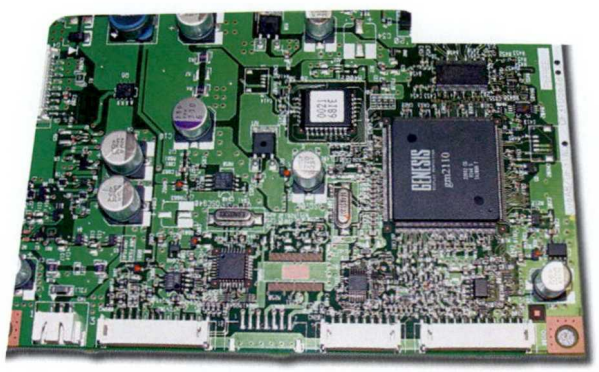
Since the use of lead-bearing materials will be prohibited in the European Union starting in July 2006, only two years are left for implementing the new materials and technologies in the European electronics industry. The pan-European network ELFNET was created to bring all the leading electronic companies like Philips, Siemens, Bosch, Hewlett Packard, etc., together with all the leading researchers in the field, in order to consolidate their efforts.

The same topic is also present in the activities of the Associated Phase Diagram and Thermodynamics Committee, and in the network of the same name, both located in IMMS and led by Professor Z. Moser - who is also the chairman of the 33rd annual CALPHAD international conference, one of whose sessions will be entirely dedicated to lead-free solder materials. ■

Further reading:

P. Zięba, J. Wojewoda, (2003). Application of diffusion soldering in lead-free interconnection technology. *Recent developments in materials science*, Research Signpost, Keralia, India, 261-282.

W. Gąsior, Z. Moser, J. Bukat, R. Kisiel, J. Sitek (2004). (Sn-Ag) eut + Cu soldering materials, Part I and II, *Journal of Phase Equilibria and Diffusion*, 25, 237-257.



IMMS

PC motherboard where most of the elements required low temperature soldering