NIHON SUPERIOR

Abstract of Proposed Nihon Superior Paper

Lead-Free Solder Formulation: You need tin, but do you need silver?"

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While the move to lead-free solders could be seen as a positive trend for the tin industry the high cost of solders that contain up to 4% silver is providing an increased incentive for finding alternatives to soldering as a method of assembling electronic circuitry. While solders that do not contain silver have been used in the commercial mass production of electronic assemblies since the early days of lead-free implementation in the late 1990s alloys based around the tin-silver-copper eutectic have been considered the default lead-free solder option. The endorsement by the IPC of the Sn-3.0%Ag-0.5%Cu alloy (commonly known as SAC305) ensured that it was the first choice of most American companies obliged to comply with the EU RoHS Directive. The key advantage that the SAC alloys were perceived to have over the tin-copper eutectic, Sn-0.7%Cu, that had also been proposed by industry consortia in Japan, Europe and America as a lower cost alternative to SAC alloy, is their lower melting point . The tin-copper eutectic has a melting point around 227°C compared with the 217-220°C melting point of the high-silver SAC alloys. The fact that SAC alloys have a tensile strength greater than that of tin-lead was seen as a bonus, apparently providing some compensation for the inconvenience of giving up lead-containing solders. As it has turned out, however, the lower melting point of the SAC alloys is not always reflected in lower process temperatures and the brittleness that goes with the high strength of the SAC alloys is a cause of failures in situations where the solder joint has to accommodate substantial strain or where it is subjected to shock loading (e.g. if a portable device such as a mobile phone is dropped). In this paper the authors will review the several factors that are prompting the electronics industry to look at ways of reducing the silver content of lead-free solders and describe the development of microalloying techniques that are making possible lead-free solders that do not rely on silver but which can match or exceed the performance and service reliability of the silver-containing solders. The authors will make the case that the cost effectiveness of microalloyed tin-copper can ensure that solders for electronics assembly will remain a strong and growing market for tin.

Keith Sweatman is a graduate metallurgical engineer and began his involvement with soldering technology with the International Tin Research Institute, an organisation that did much of the work that established a scientific basis for what was previously the art of soldering. He took that experience with him to Multicore Solders where he worked in a variety of technical and management roles that culminated in the position of managing director of Multicore Solders operations in the Asia Pacific Region. Since 2001 he has been assisting Nihon Superior Co, Ltd. in the development of their global business in lead-free solders. Over that period he has given some 30 presentations at conferences and seminars around the world and published articles in various industry journals. Currently he represents Nihon Superior in projects related to lead-free soldering technology in iNEMI and the HDP User Group and in the NASA/US Department of Defence lead-free solder project. He is a corresponding member of several IPC standards committees relating to soldering technology and is a member of the technical committee of the IPC Solder Products Value Council.

Tetsuro Nishimura is the president of Nihon Superior Co., Ltd. He is a graduate in metallurgy and the pioneer in the development of microalloyed solders holding the patent for the use of a trace addition of nickel to turn the tin-copper eutectic into a reliable solder that is now widely used around the world. He has been active in solder industry technical committees in Japan, written many papers and articles for publication in Japan and overseas, and presented numerous papers at conferences in Japan and overseas. He has overseen the expansion of Nihon Superior to its current position as a major supplier of lead-free solder to the global electronics industry