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Simple synthesis of cu dendrites and novel die attach method using rapid sinterability of the dendrites

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Abstract

For sinter-bonding of wide-bandgap power devices or high heat-generating devices on Cu finish metallization in air, a low cost bonding material, i.e., a paste containing synthesized Cu dendrites, was prepared. The Cu dendritic particles were synthesized within 5 min under ambient conditions by adding an initiator into a CuSO4 aqueous solution. This technique to synthesize modified dendrites is simple and suitable for mass production. The synthesized Cu dendrites indicated a small average size of 4.44 μm and short, multiple branches linked with backbone stems. While the dendrite stem was a polycrystal grown only on the (111) plane, the branches consisted of three planes (111), (200), and (220), indicating that they were formed by random attachment of nanoparticles and aggregates. Furthermore, they exhibited larger surface area by formation of bumpy surfaces. Die-attach properties at 250-350 °C were examined under the external pressure of 2–10 MPa with respect to bonding time. Tiny Cu nanoparticles were in situ formed by reduction of the surface oxide skin of Cu dendrites during heating in air for the bonding, which facilitated the sinter-bonding. As a result, the sinter-bonding at 2 MPa and 300 °C for 30 s and additional pressure less annealing for 20 min led to robust bonding exceeding 21 MPa in shear strength. Compared with current pressure sinter-bonding technologies of approximately 20 min, the drastic reduction in the bonding time under pressure provides feasibility of continuous production using a conveyor system.

Biography

Jong Hyun Lee received the PhD in metallurgy and materials science from Hong Ik University, Seoul, Korea, in 2001. From 2001 to 2005, he was with ETRI, where he was involved in developing optoelectronic packages. In 2005, he was with Memory Device Division, Samsung Electronics Corporation. From 2006 to 2008, he was a senior researcher of KITECH (Korea Institute of Industrial Technology), where he worked on electronic packaging materials and processes. Since 2008, he has been working as a professor at department of materials science and engineering, Seoul National University of Science and Technology. His current research interests are in the areas of electronic packaging materials and application of nanomaterial's.

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