

Improvements of Backside Grinding/Metal (BGBM) and Die Bonding for MOSFET Power IC Packages

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For the manufacturing of MOSFET power IC packages, a Si wafer was thinned to a thickness less than 100 μm , metalized with multi- thin films and then bonded to a substrate. Traditionally, a Ti/Ni/Ag multilayer has been widely employed for the backside metallization process. However, the most root cause occurred at the Ni/Ag interface due to the weak cohesion between Ni and Ag. In addition, TiSi intermetallic compounds might appear at the Si/Ti interface, leading to a brittle fracture of the package. In this study, a 0.5 μm thin Sn film was inserted between Ni and Ag to increase the bonding strength of Ni/Ag interface, and the Ti film was replaced with a WTi film to prevent the brittle fracture at Si/Ti interface.

Additionally, Ti/WTi/Ti triple-films were also employed to improve the bonding effect of Ti with Si chips. Furthermore, conventional soldering method has been applied for the die attachment of backside treated IC chips with direct copper bonding (DBC) substrates using an expensive Au-20 Sn alloy. The melting temperature of this eutectic Au-20Sn solder (278 $^{\circ}\text{C}$) limited the operating temperature of power IC packages. A low cost Solid Liquid Inter-diffusion Bonding (SLID) technique was evaluated for the die bonding to increase the durability of the product to 400 $^{\circ}\text{C}$. For this purpose, a 4 μm Sn film was deposited on the Ag surface of backside metallized Si/Ti/Ni/Ag chips and heated at 300 $^{\circ}\text{C}$ for 10 min. During the SLID process, the molten Sn interlayer reacted completely with Ag film on Chip-side and Cu pad on DBC substrate to form Ag₃Sn and Cu₆Sn₅ intermetallic phases, which have high melting points of 480 $^{\circ}\text{C}$ and 415 $^{\circ}\text{C}$, respectively.

Biography:

Yan-Cheng Lin received the Ph.D. degree from the Department of Materials Science and Engineering, National Taiwan University, Taipei, Taiwan, in 2016. He is currently a Research & Development Engineer with the Wire Technology Co., Ltd, Taichung, Taiwan and Ag Materials Technology Co., Hsinchu, Taiwan. He has authored sixteen Science Citation Index papers on Ag-alloy bonding wire, thermoelectric modules, and optical recording thin films. His current research interests include integrated circuit bonding wire, electronic packages, thin-film technology, and thermoelectric materials.