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A Review on the Mechanisms of Ultrasonic Wedge-Wedge Bonding

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Abstract

Although ultrasonic (US) wire bonding has been widely applied in microelectronic packaging industry for decades, the bonding mechanisms are not yet well understood. This article reviews the state-of-the-art understanding of the wedge-wedge bonding mechanisms and its four phases 1) Pre-deformation and activation of US vibration, 2) Friction, 3) US softening and 4) Interdiffusion. The aim of this review is to provide fundamental insight into the bonding process and guidance for future research.

By surveying existing work in the field, several gaps in current knowledge of the bonding mechanisms can be identified: 1) the relative motion behaviors between wire, substrate and bonding tool are uncertain; 2) the exact local temperature increments at the wire/substrate interface and the role of these temperature increments are not known; 3) the oxides removal mechanism is not well understood, mainly due to the nano-size of oxides and the very short duration of the self-cleaning process; 4) the understanding of the softening mechanism is incomplete and the influence of the softening on the substrate has not been examined; 5) the microwelds formation and breakage rates have been analyzed, neither experimentally nor numerically. Filling these gaps has the potential to further enhance the US wire bonding process.

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