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Numerical and experimental investigations in ultrasonic heavy wire bonding

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Ultrasonic wedge/wedge-wire bonding is used to connect electrical terminals of semiconductor modules in power electronics. The wire is clamped with a tool by a normal force and ultrasonic vibration is transmitted through the wire into the interface between wire and substrate [1]. Due to the frictional processes contaminations like oxide layers are removed from the contact zone and the surface roughness is reduced, thus the real contact area is increased [2]. In the next step of bond formation, thermomechanical forces create micro-junctions between the wire and substrate and the bond strength increases [3].
The bond parameters like the bond normal force, the ultrasonic vibration amplitude and the geometry of the clamping tool show a high influence on the strength and reliability of the wire bond and need to be investigated in detail. Therefore, in this contribution the dynamical behaviour of the ultrasonic system, the wire and the substrate are modelled in form of substructures, which are connected by the friction contacts between tool and wire and between wire and substrate. Approaches for modelling the time variant contact behaviour, the substrate dynamics, and the model order reduction for a time efficient simulation are described to simulate the full bonding process.

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