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The effect of the bonded interface damage on mechanical and electro-thermal characteristics of the IGBT Modules

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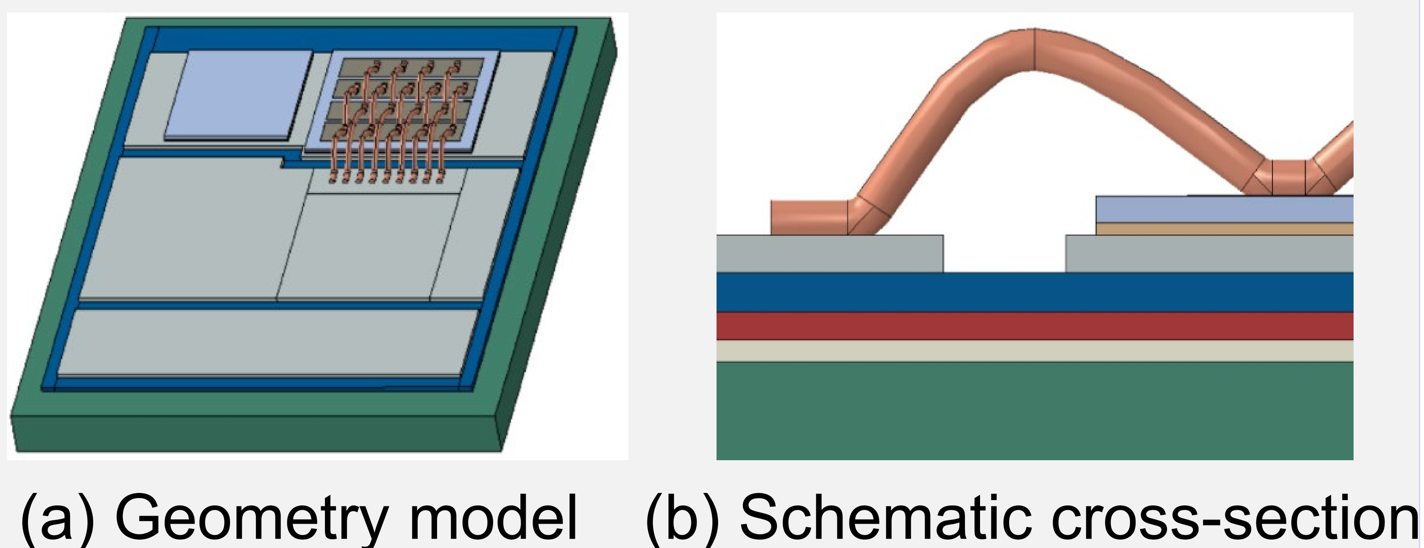
Introduction

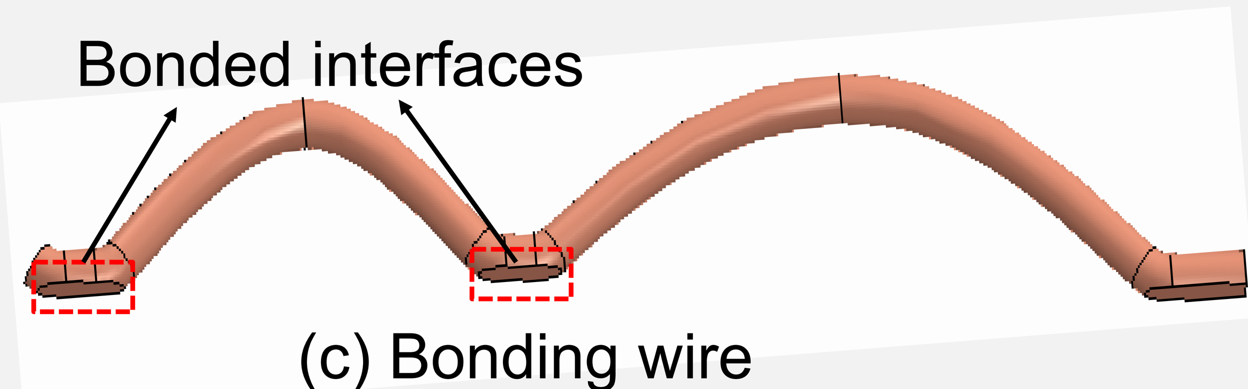
For IGBT modules using wire bonding as the interconnection method, the primary failure mechanism is the cracking of the bonded interface between the bonding wire and Al mentalization. Studying the effect of the bonded interface damage on mechanical and electro-thermal characteristics is crucial for assessing the reliability of IGBT modules.

In this paper, established several finite element models of IGBT modules with different bonded areas and accomplished a two-step indirect coupling electro-thermal-mechanical analysis under power cycling. Then, we analyzed the influence of bonded interface damage on the electro-thermal-mechanical parameters, which included turn-on voltage (V_{ce}), maximum temperature (T_{max}), current density, and displacement of the bonding wires. These studies provide theoretical guidance for a comprehensive understanding of the packaging failure of the IGBT module.

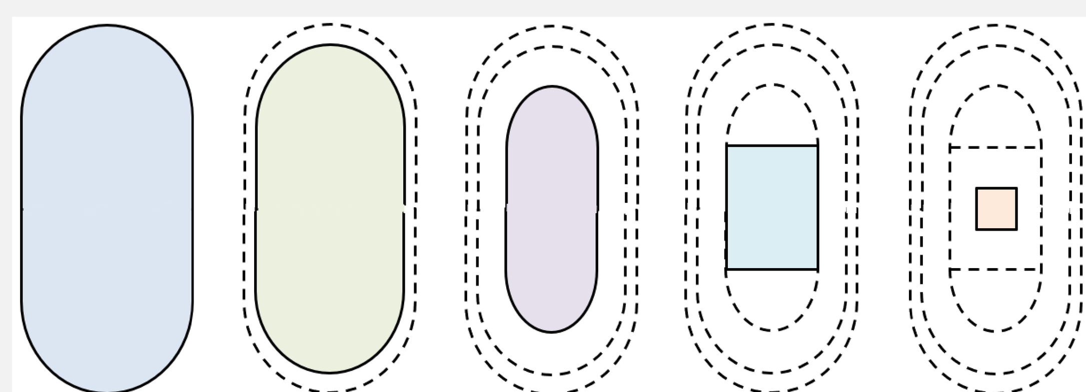
The FE model



(a) Geometry model (b) Schematic cross-section

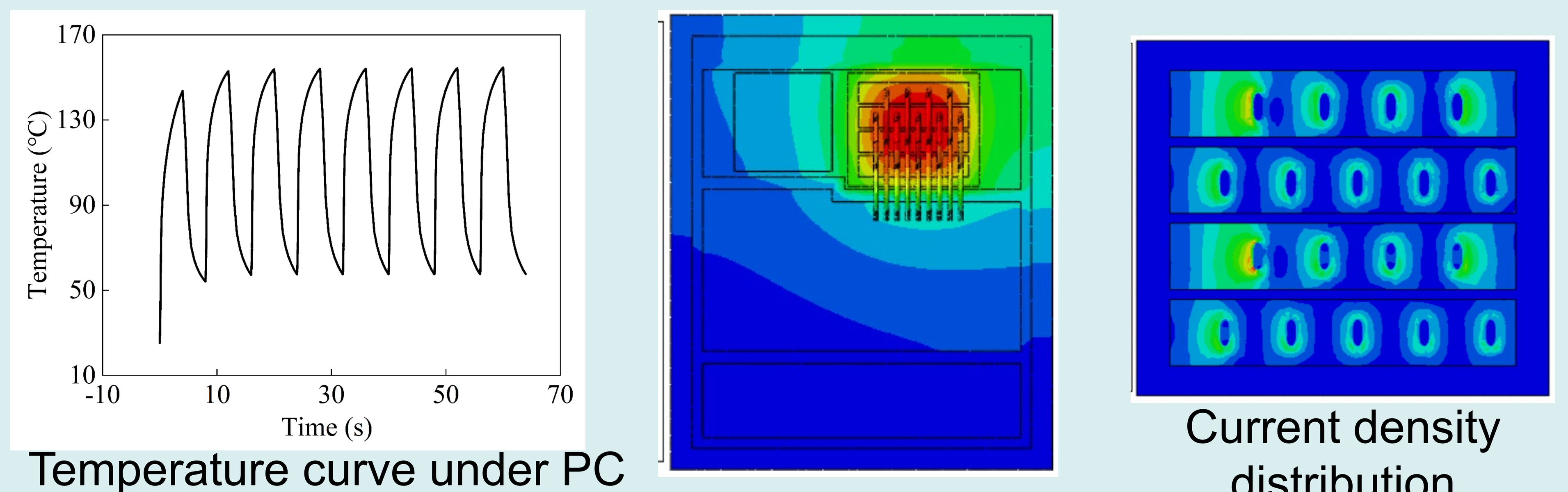


(c) Bonding wire



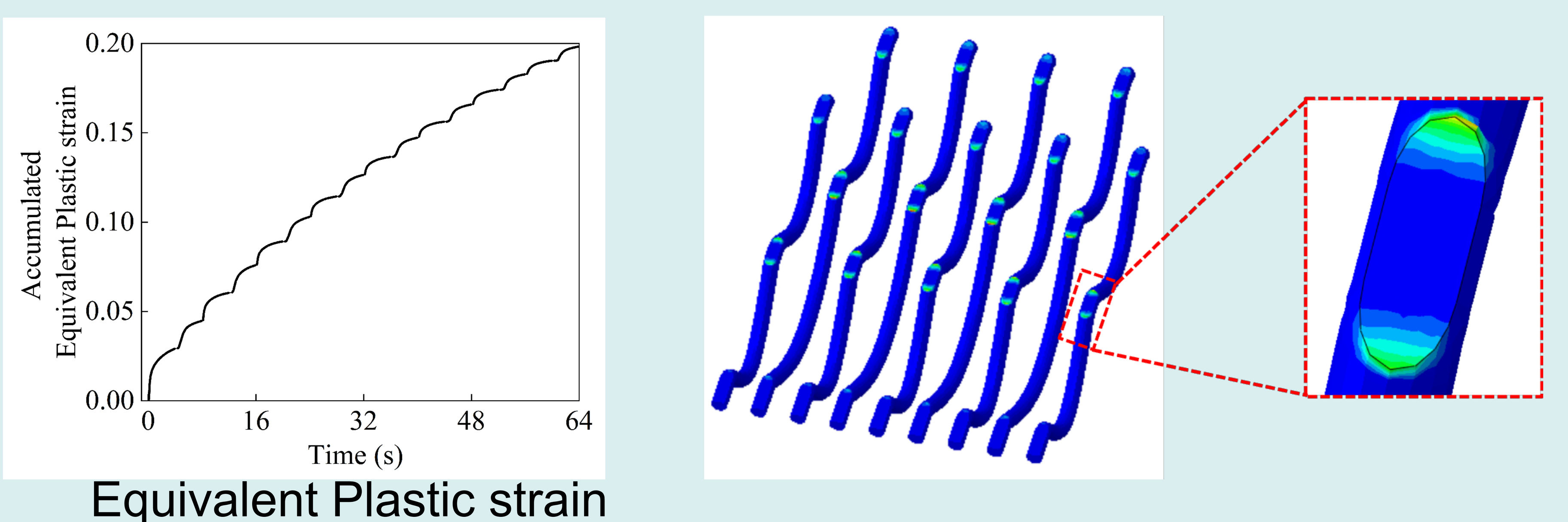
(d) Five damage state of Bonded interfaces

The FE analysis resultls



Temperature curve under PC

Current density distribution



Equivalent Plastic strain

von Mises stress

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