INTERCONNECTS

Orientated against failure

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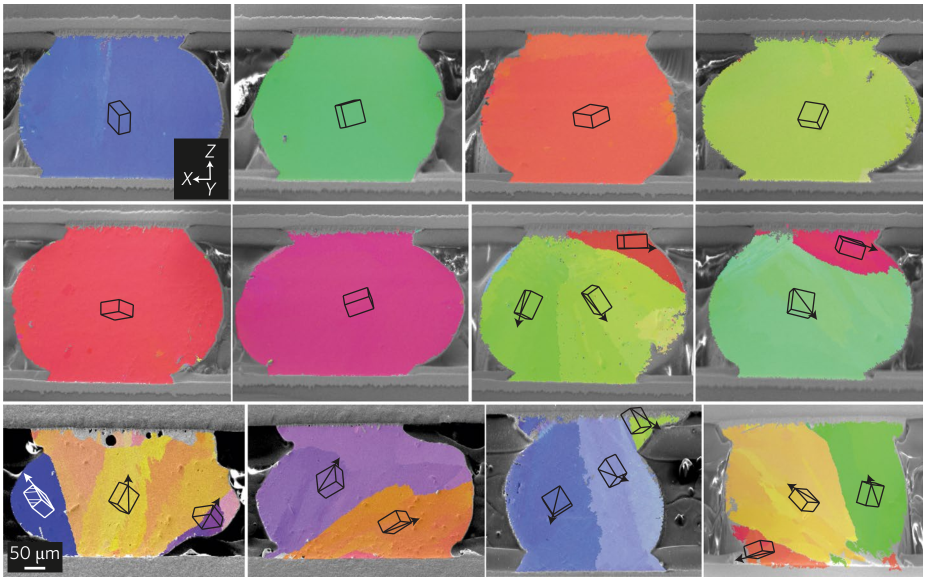

Credit: Macmillan Publishers Ltd

Solder joints in electronic systems endure high current densities, mechanical loading and thermal cycling. Over time, these stresses can lead to failure due to electromigration, thermomigration, thermal fatigue or mechanical fatigue. For solder joints based on β-tin, which has a tetragonal crystal structure, the failure modes are strongly correlated to different grain orientations. In general, solder joints occur with a wide distribution of crystal orientations and as a result their robustness against certain failure modes is often random. Zhaolong Ma, Christopher Gourlay and colleagues at Imperial College London and the Nihon Superior Company have now developed an approach to control the orientation of β-tin solder joints and to design joints that can mitigate specific failure modes.

The researchers controlled the orientation of the joints by regulating the nucleation event, which is largely governed by the choice of seed crystal. They selected, in particular, metal stannide seed crystals that had an appropriate lattice match to β-tin: $PtSn_4$, $\alpha CoSn_3$ and $\beta IrSn_4$. Then, in order to study the nucleation under cooling, and subsequently determine the orientation relationships, droplets of tin were solidified on the facets of the different stannide crystals. Finally, Ma and colleagues used their nucleation approach to create ball grid array solder joints that had a well-defined β-tin microstructure and grain orientation.

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