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MULTISCALE ANALYSIS OF RESIDUAL STRESSES DURING PROCESSING OF NANO-BASED INTERCONNECT MATERIALS

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Promising new interconnect materials in high power electronic devices are composed of nano- and micro-based silver particles immersed in a polymer matrix. For these materials, the processing induced residual stress plays an important role on the reliability and lifetime of the devices. Computational methods can be used in predicting the influence of processing parameters on the residual stress in the interconnect materials. Due to the large length scale difference between the silver particles (tens of nanometers to few micrometers) and the interconnect (few milimeters), full-scale simulation of the interconnect material considering microstructure details is computationally infeasible. In this paper, a multiscale scheme based on computational homogenization [1] is used to link the material microstructure level with the device level with high computational accuracy and flexibility while including nonlinear material behavior. During processing, the stress evolution within the interconnect depends on the viscoelastic and curing properties of the polymer matrix, the elastoplastic properties of the Ag particles and the particle properties (such as size, shape and volume fraction). Realistic microstructures of silver-based adhesives are obtained from actual cross-sections. The stresses in both material microstructure and device level are calculated in a nested way. A detailed parameter study is carried out to determine the influence of the processing temperature profiles on the residual stress. Suggestions on designing processing profiles in order to reduce the residual stress are given.

REFERENCES

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