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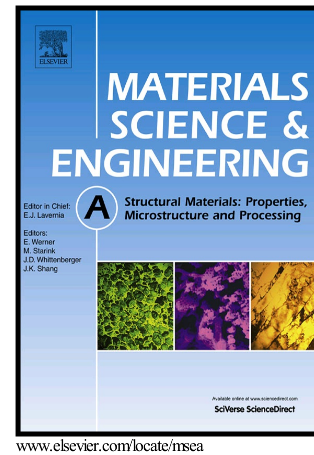

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Role of Surface Oxide in Mitigating Tin Whisker Growth: A Finite Element Study

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Abstract

The growth of tin whiskers on fine pitched Sn-plated interconnect lines poses catastrophic short circuit problems in electronic components, especially those with long service lives like in space, defense and transportation industries. In the past, this problem was mitigated by the addition of a few percent Pb, but the current worldwide ban on Pb precludes this approach. In our previous work, it has been shown that 5-10% indium completely eliminates whisker growth in electroplated tin on copper substrates and it has been proposed that modification of the surface oxide layer properties is a potential reason for the observed elimination. In this paper, we study the effect of the surface-oxide layer in modifying the stress state and hence the driving force for diffusion within Sn-films, and investigate the effects of (i) different oxide-layer stiffnesses, (ii) the presence of a central break in the oxide layer, (iii) the presence of periodic breaks in the oxide, and (iv) an oxide layer with periodic inserts of In-oxide using finite element modeling (FEM). All the models were constructed using the commercial finite element software ANSYS and the stress distribution in each model was analyzed.

Keywords: whisker, indium, surface-oxide, stress, diffusion, finite-element modeling

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