SAND2011-3952C

Center for Advanced
Life Cycle Engineering

Tin Whisker Symposium Abstract Submission

Paper Title: **Crystallographic Analysis of Tin Whiskers with SEM/EBSD**

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Abstract

Crystallographic characterization of whiskers includes the determination of the axis of growth, the axis perpendicular to the substrate (the orientation of the "origin" Sn grain) and the physical angle of the whisker with respect to the sample surface normal. Techniques were developed in this work to obtain these parameters "in-situ", without removal of the whiskers from the substrate. First a whisker is aligned with the tilt axis of the SEM and the projected length of the whisker measured. The sample is then carefully tilted for EBSD and patterns from the whisker are collected and indexed and the orientation matrix recorded. Simple geometric analysis allows the angle of the whisker with respect to the surface to be measured from SEM images. The whisker growth axis may be precisely determined through mathematical rotation of the measured orientation matrix using the independently measured whisker angle. This method is preferred as it allows the growth axis of the whisker and the surface normal of the grain from which the whisker grew to be measured and the associated growth angle determined independently.

So far, thirty-one whiskers were analyzed with the in-situ technique. The growth axes of these whiskers were combined with data from 37 other whiskers analyzed after removal from the substrate. Based on data from these 68 individual whiskers, the growth directions were determined, in decreasing order of prevalence, to be: <001>, <010>, <011>, <111>, <110>, and <112>. Only two <110> whiskers and one <112> whisker were found. By obtaining both the growth axis of the whisker and the normal direction with respect to the Sn plated surface, we determined that there

was no unique relationship between the whisker growth direction and the orientation of the grain from which it grew. Preliminary analysis of the overall crystallographic texture of the Sn plate also suggested there was no correlation with the texture of the film. That is, the grains from which the whiskers grew did not usually correspond to the preferred orientations of grains within the film. Finally, based on the aforementioned results, it follows that the crystallography of the whisker cannot be implied from knowledge of the physical growth angle alone.

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