

# Tin Whisker To Dos-2010

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iNEMI chair 2002-2005 Whisker Fundamentals Comm.

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# Overview of whisker issues

- Fair (in my opinion) consensus on:
  - Diffusion gated stress relief process
  - Compressive stress required somewhere
  - Importance of Positive stress gradient
  - Whisker grain / grain boundary slip
- Some whisker issues with “less resolution”
  - Why whiskers form where they do
  - Why (and how) whiskers “kink”
  - Explanation for “subsidence”/pedestal formation
  - Substrate effects: minor elements/gr. Size & orientation
  - Relevance of film/substrate inter-diffusion (Kirkendall eff.)

# Gallery of Photos

a) kink (b) pedestal (c) plan view (d) plan view-whisker root

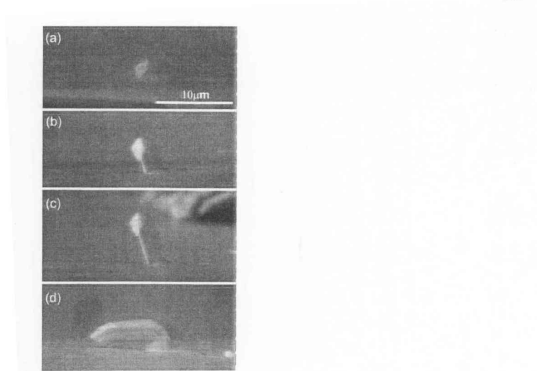
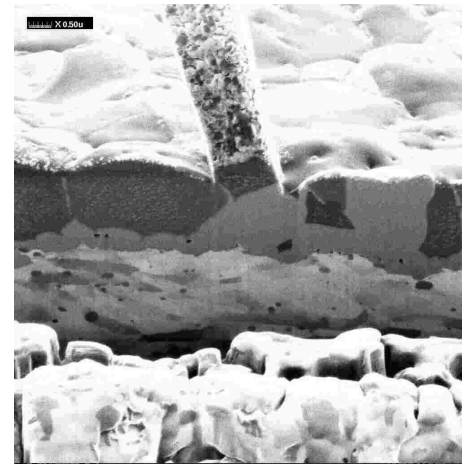
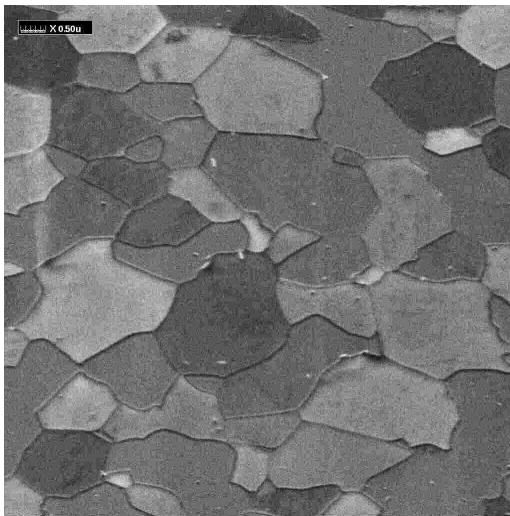


FIG. 48 Growth of a Sn whisker at the anode of a test sample of pure Sn under electromigration at 150°C and  $10^{-5}$  A/cm<sup>2</sup> for: (a) 20 hr, (b) 40 hr, (c) 60 hr, (d) 80 hr (Courtesy of W. Choi, UCLA.)

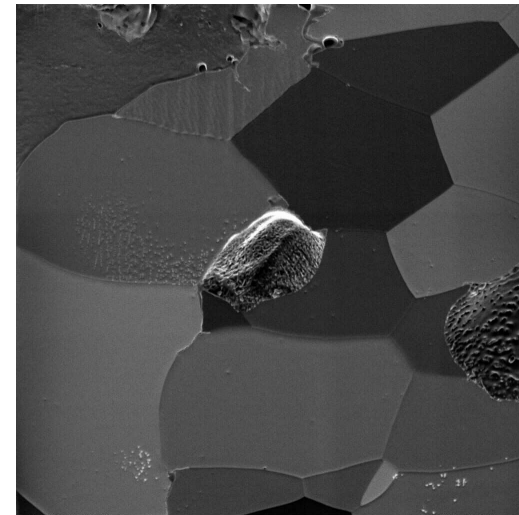
(a) ref. W. Choi, K.N. Tu: Petch expt.



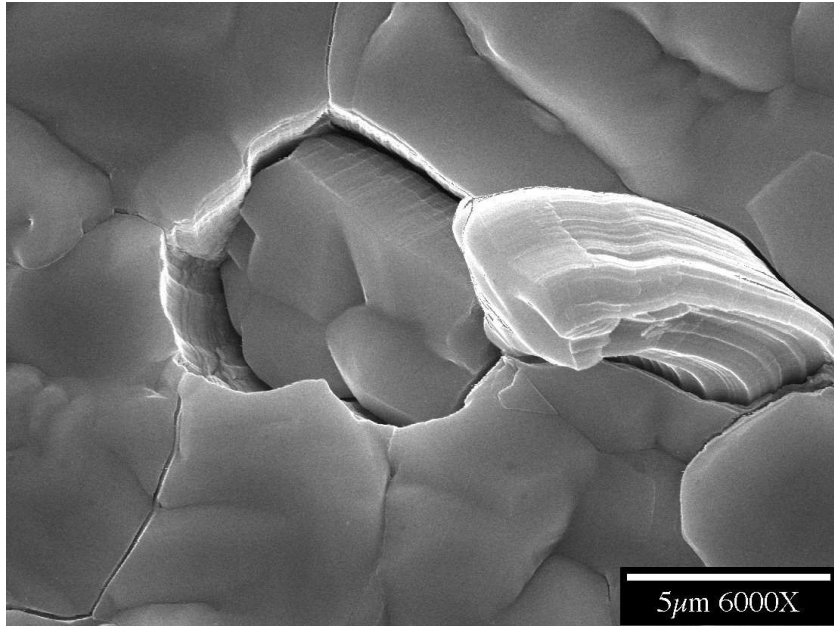
(b) ref. Galyon; TCed sample



(c) ref. Galyon: Plan view film surface



(d) ref. Galyon: PV whisker root



Subsidence Photos-courtesy Peter Bush SUNY

To my knowledge never shown/discussed outside of iNEMI whisker fundamentals group/workshops

Usually associated with thermal cycling  
e.g. -40 to +80 degs. C

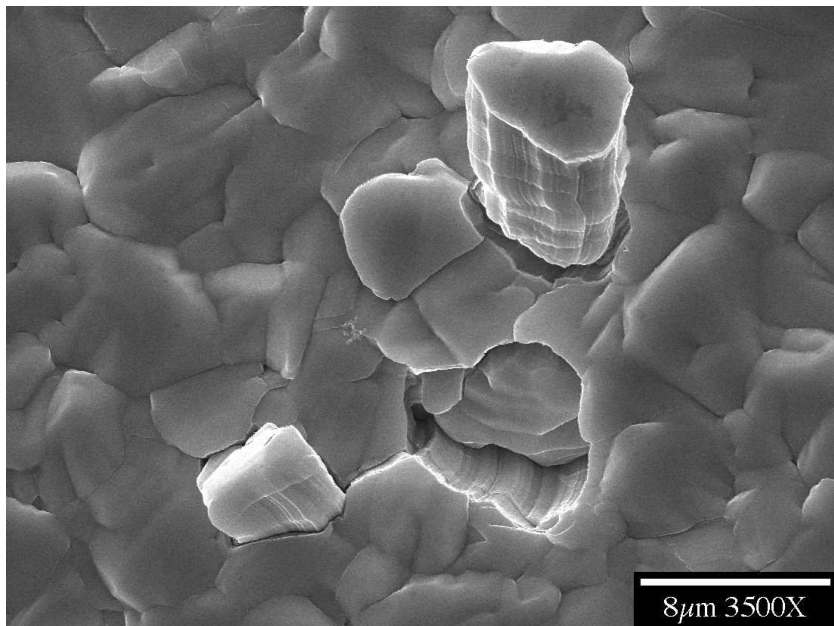
Very evident on TCed Sn/Ni couples

Open Questions:

What distinguishes the subsided grains?

Are the SGs “feeding” the whisker?

Is TCing necessary to see subsidence?  
if so-why?



# Some “questions” going forward

- Pedestals: extraordinary gr. Bdry. Diffusion?
- Subsidences: extraordinary compressive stress?
- Whisker formation: at gr. Bdry. Nodes?
  - Ref. Peng Su, et al. Concept of strain energy density
  - Plan Views of whisker roots too few in number today
- Kinks:
  - Do whiskers “kink” at their “tips” or at their roots?
  - What are the orientation relationships across kink ?
    - Is some kind of “twinning” involved?

FYI: An example of a high “convoluted” kinked whisker

