



LOMSS

Reliability Evaluation of Conformal Coatings against Tin Whisker Growth

Objectives:

- To develop a test procedure for conformal coatings to assess effectiveness of tin whisker failure mitigation
- To characterize the degradation of conformal coating subjected to operating and storage conditions
- To develop a PoF model to evaluate the performance of conformal coating to prevent short failure by tin whisker growth



Background

- Tin whiskers are conductive crystals that can spontaneously grow from pure tin and high tin content alloy finishes.
- The major failure caused by tin whiskers is electrical shorting due to bridging between adjacent conductors.
- Conformal coating is a polymeric layer, that was designed to protect the surfaces from harsh environments such as mold, moisture, and chemicals.
- In terms of tin whisker mitigation, a conformal coating may prevent whiskers from contacting a coated surface and contain whiskers under the coated surface.



Contain Whisker

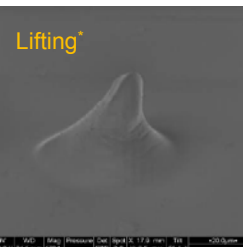
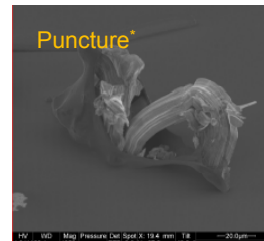


Prevent Contact



Two Observed Failures of Coating

- Silicone (SR) Coating Tests
 - Simple puncture observed
 - Dominate failure mode: *Puncture Failure*
- Urethane (UR) Coating Tests
 - Whiskers were contained before breaking out of the coating
 - Failure Mode: *Adhesive and Puncture Failure*
- Each failure mode was tested in two accelerated testing environments

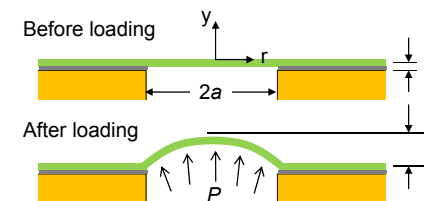


* Panashchenko, "Long Term Investigation of Urethane Conformal Coating Against Tin Whisker Growth", <http://nepp.nasa.gov/whisker/>, July 2010



Testing Approach

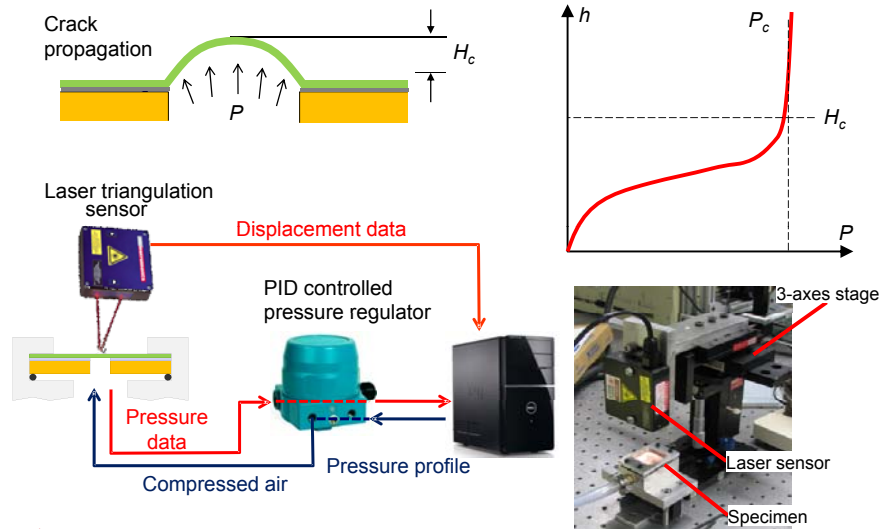
- Blister-type Testing
 - Due to the nature of the coating, a larger experimental whisker diameter can be used during testing
 - Advantages
 - Mimics tin whisker growth
 - Allows for quantitative comparison of rupture and adhesion strengths
 - Specimens can be subjected to accelerated testing environments



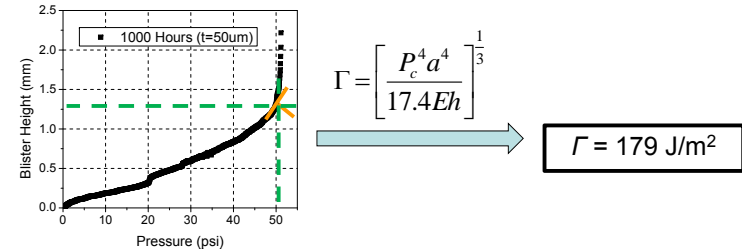
Contain Whisker



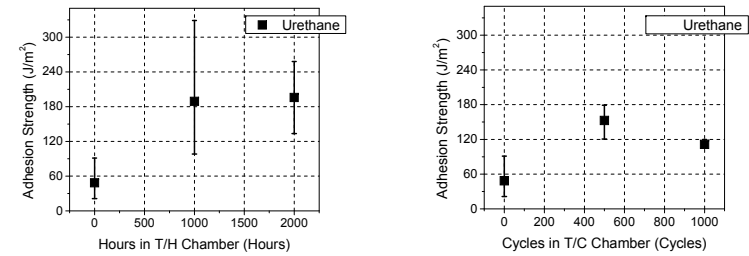
Adhesive Strength Testing



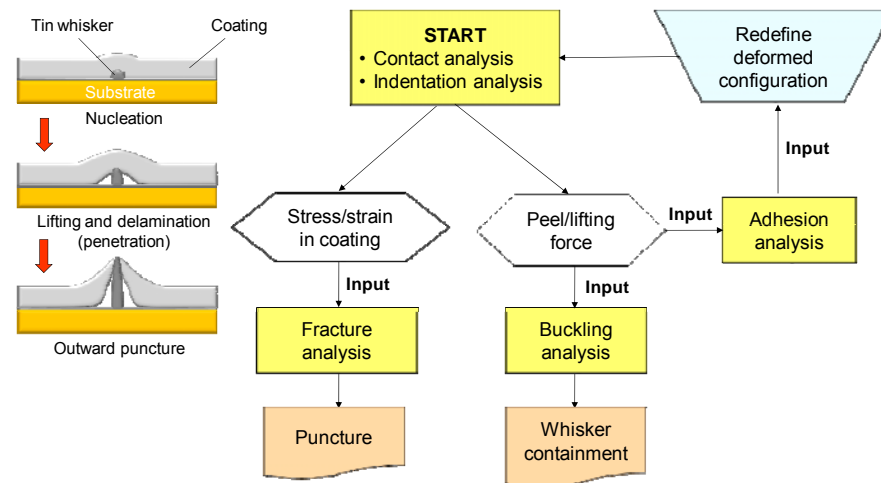
Adhesion Strength from Test Data



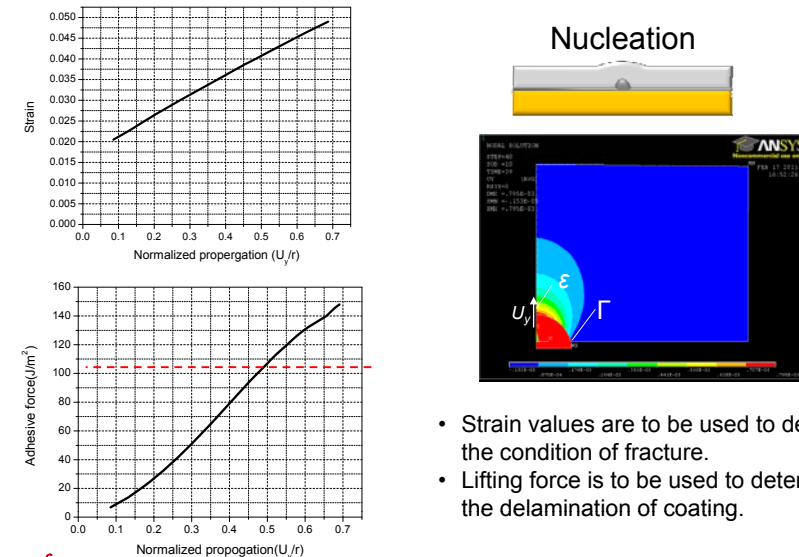
Accelerated Testing:



Flow Chart of Proposed Modeling Approach



Preliminary FE Modeling of Nucleation



- Strain values are to be used to determine the condition of fracture.
- Lifting force is to be used to determine the delamination of coating.