

## Growth of conductive metallic “tin whiskers” and random electrical shorting events implicated in Toyota’s uncontrollable vehicle acceleration safety problems

Whisker shorting issue analogous to metallic dendrite shorting events that can cause LENRs which can then trigger super-hot, fast-burning metal oxidation fires in Li-ion batteries

Other major difference from Li-ion batteries is frequency of occurrence: looks like potential for LENR triggering is 1 out of every ~5 million cells (battery manufacturer estimate) vs. est. of 140 whisker-related shorting failures per 1 million (= 700 per 5 million) Toyota vehicles

**Note: micron-scale LENRs very likely do not often occur in Toyota whisker micro-arcs**

### References:

“Lattice Energy LLC - Could LENRs be involved in some Li-ion battery fires? LENRs in advanced batteries”

Lewis Larsen, Lattice Energy LLC, July 16, 2010 [68 slides – not refereed]

Discusses possibility that LENRs may be occurring in some indeterminate subset of Li-ion battery fires

<http://www.slideshare.net/lewisglarsen/cfakepathlattice-energy-llc-len-rs-in-liion-battery-firesjuly-16-2010>

“Toyota’s Sudden Acceleration Problem May Have Been Triggered By Tin Whiskers”

Sharon Carty, Reporter

Huffington Post - first Posted: 01/22/2012 7:07 pm Updated: 01/23/2012 5:26 pm

[http://www.huffingtonpost.com/2012/01/21/toyota-sudden-acceleration-tin-whiskers\\_n\\_1221076.html](http://www.huffingtonpost.com/2012/01/21/toyota-sudden-acceleration-tin-whiskers_n_1221076.html)

“Toyota accelerations revisited—hanging by a (tin) whisker”

Rick DeMeis, Editor of *Automotive Designline*

*EE Times* - News and Analysis 1/10/2012 8:39 AM EST

<http://www.eetimes.com/electronics-news/4234309/Toyota-accelerations-revisited-hanging-by-a--tin--whisker>

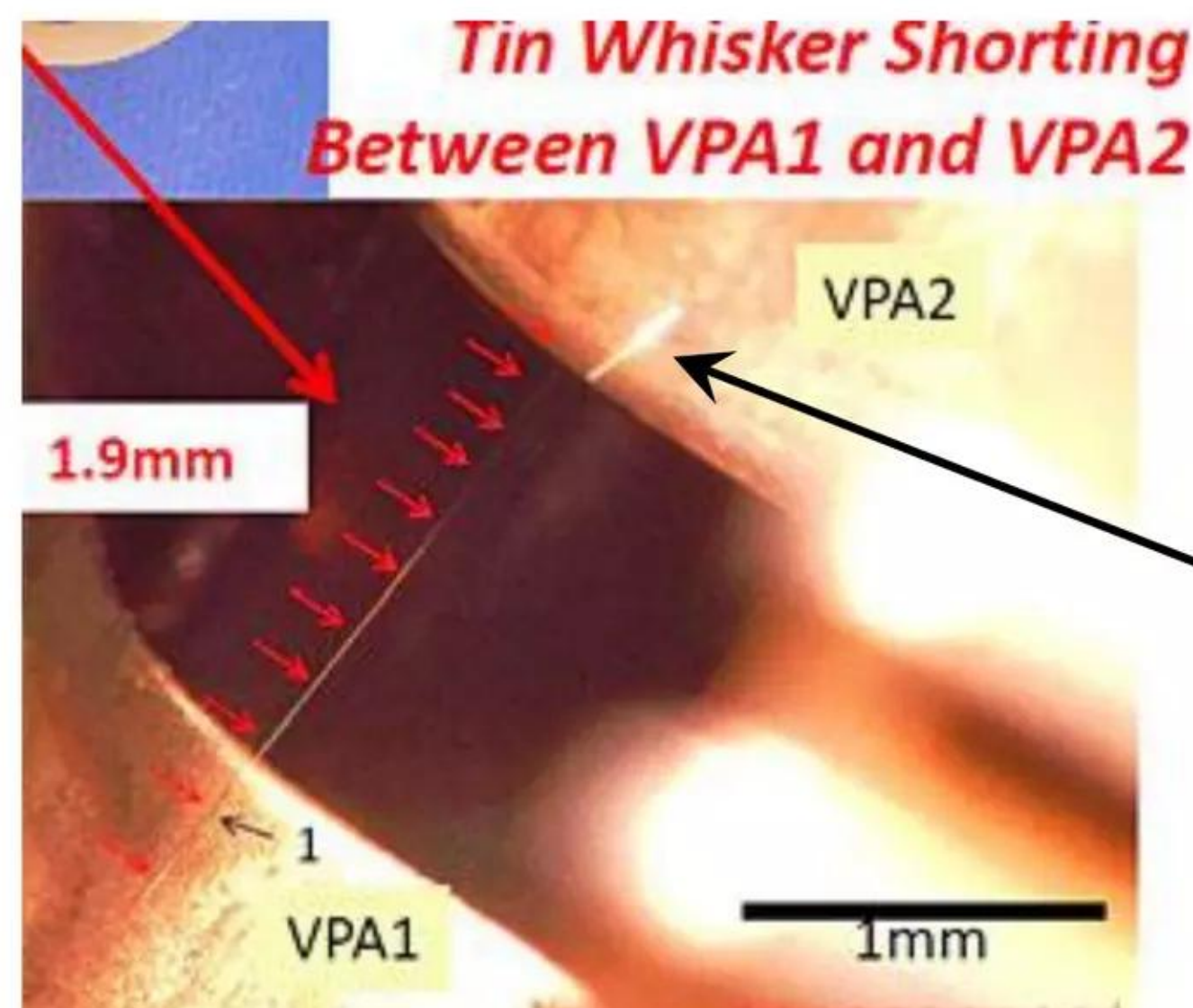
“Electrical Failure of an Accelerator Pedal Position Sensor Caused by a Tin Whisker and Discussion of Investigative Techniques Used for Whisker Detection”

H. Leidecker (NASA Goddard), L. Panashchenko (NASA Goddard), & J. Brusse (Dell Federal Govt Svcs) September 14, 2011 NASA

[http://nepp.nasa.gov/whisker/reference/tech\\_papers/2011-NASA-GSFC-whisker-failure-app-sensor.pdf](http://nepp.nasa.gov/whisker/reference/tech_papers/2011-NASA-GSFC-whisker-failure-app-sensor.pdf)

### Caught in the act!

Image credit and source:  
above-cited NASA report  
on Slide #17



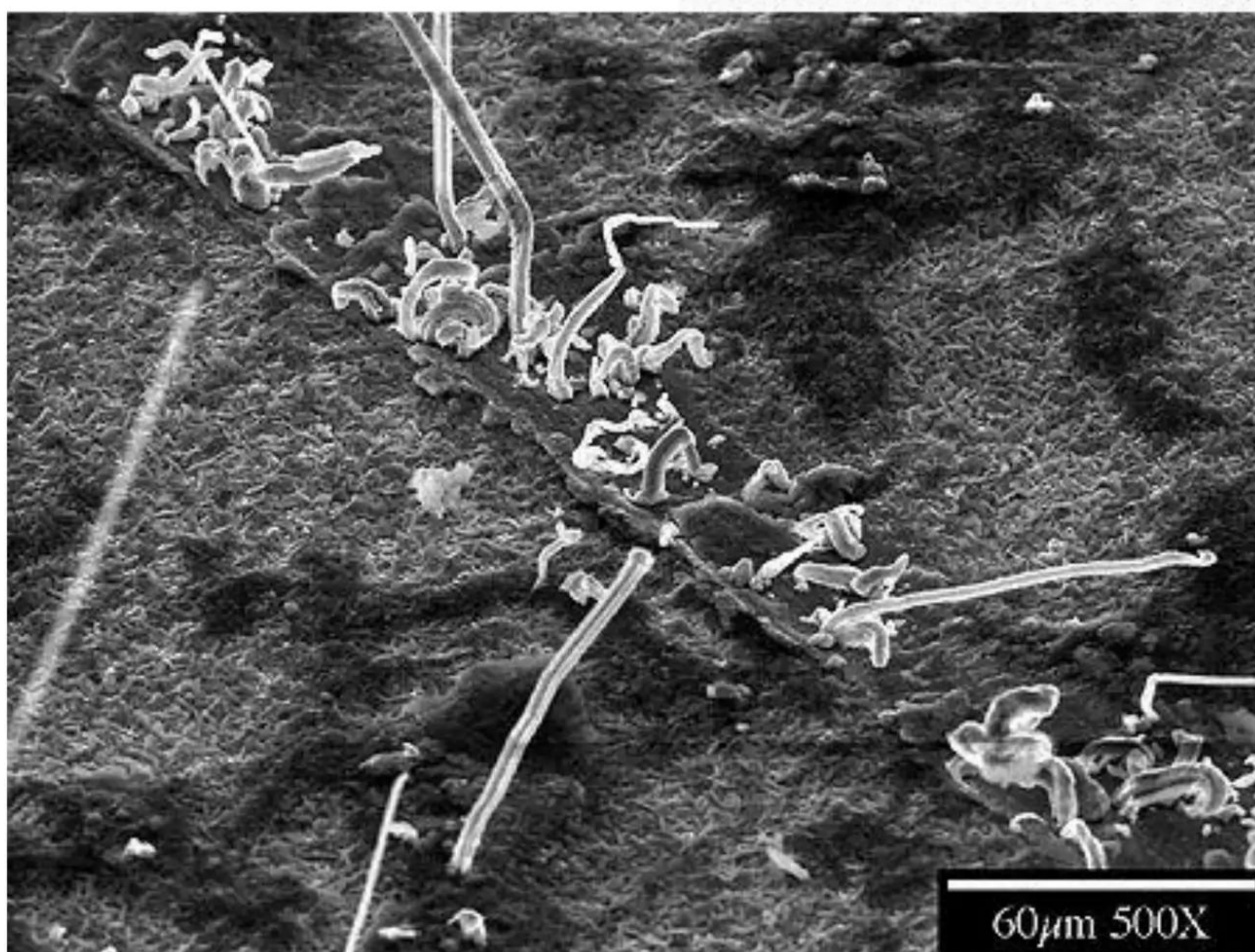
Note electrical arc (spark)  
emitted from the sharp tip  
of the tin whisker



### **Example of lithium metal dendrites growing in Li-ion battery electrolyte**



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### **Example of zinc whiskers growing on top of substrate**