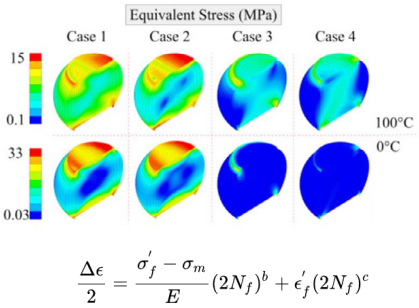
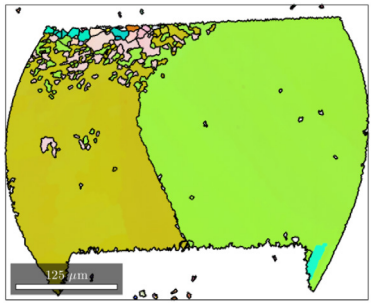



$$\frac{\Delta\epsilon}{2} = \frac{\sigma_f' - \sigma_m}{E}(2N_f)^b + \epsilon_f'(2N_f)^c$$




# Accelerated Testing of Solder Joints – It Doesn't Have to be a Waste of Time and Money

## Seminar 13 November 2018 – Gothenburg, Sweden

Accelerated testing is of course only meaningful if the results tell us something about the anticipated performance in service. Even if we cannot predict actual life, we need our tests to at least tell us which material, design, or process will perform best under realistic use conditions. This requires not only properly defined tests but also guidelines as to how to interpret test results. When it comes to solder joints 'best in test' may often not mean 'best in service', i.e. we need a mechanistically justified picture or model.

The behavior of SnAgCu based solder under combinations of aging, thermal excursions, vibration and interactions between these is considerably more complicated than that of SnPb. However, access to a unique range of systematic test results together with Materials Science based research into the underlying mechanisms has by now led to the establishment of a comprehensive understanding. This presentation will start with demonstrations of how common models fail to predict even accelerated test results. This will be followed by a tutorial description and explanation of the evolution of the microstructure and the resulting deformation and damage properties. That will include an explanation of how the partial cancellation of major errors in the constitutive relations and damage functions assumed have allowed the breakdown of current models to go largely unnoticed. A mechanistic model for life under realistic long term service conditions will then be outlined and justified. This model not only shows how factors that have limited effects on accelerated test results often dominate life in use, it also offers guidelines for the definition of a variety of tests and the interpretation of test results.

In addition to Prof. Borgesen's presentation, results from a Swedish national project will be presented. In this project, it has been evaluated how the lives of lead-free solder joints to various types of components are affected by various parameters including grain structure, conformal coatings and test conditions. The test results show that the grain structure may vary a lot even for solder joints to the same component and that conformal coatings may cause a reduction of the fatigue lives with up to 90 %. They also show that the acceleration factor differ for different types of packages.

### Agenda

09.30 Registration and coffee
10.00 Accelerated Testing of Solder Joints (Peter Borgesen)
12.00 Lunch
13.00 Accelerated Testing of Solder Joints, cont'd
15.00 Coffee
15.20 Results from a Swedish project (Per-Erik Tegehall, Swerea IVF)
17.00 End of seminar

The seminar is organised in cooperation with Smartare Elektroniksystem (Electronic Components and Systems)

**Presenter:**

Peter Borgesen
Professor of Systems Science & Industrial Engineering
T. J. Watson School of Engineering & Applied Science
Binghamton University

**Location:**

Gothia Towers
Mässans gata 24
Gothenburg, Sweden

**Participation fee:**

SEK 2,000 before Oct. 19
SEK 2,500 after Oct. 19
(includes coffee and lunch)

**Last day for registration:**

Nov. 1, 2018
Limited number of seats

**Registration:**

*www.swerea.se/en/calendar/life-assessment-electronics*
Registration is binding

**Contact person:**

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**Peter Borgesen** earned his Ph. D. in Physics from University of Aarhus while working at Riso National Laboratory in Denmark. After 4 years as a post doc at the Max-Planck-Institute for Plasmaphysics in Garching, Germany, he joined the Materials Science & Engineering Department at Cornell University in Ithaca, NY. 8 years later he left for industry where he spent 15 years at Universal Instruments managing a multimillion dollar process and reliability research effort funded by an international consortium of major companies from across the microelectronics industry. In 2009 he was finally recruited by Binghamton University where he is a Professor of Systems Science & Industrial Engineering and of Materials Science. His group there includes 8 Ph. D. students, 5-8 Master's students and a varying number of undergraduates, all conducting research aimed at understanding aspects of reliability, how to test and how to interpret results.

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