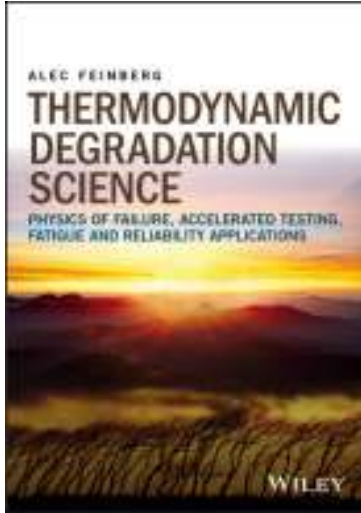


## *DfRSoftware Physics of Failure Course*

### *Physics of Failure, Tools, Mechanisms, Modeling and Measurements (including FDS and the New Mesoscopic Measurement Methods)*



There are many aspects to the science of physics of failure. In this course we approach the subject by dividing it up into four main sections

#### Physics of Failure

- Tools
- Mechanisms
- Modeling
- And measurement techniques

The following outline provides an overview for each section

#### *Physics of Failure Tools*

- SEM (FE-SEM, EDS)
- Digital Microscopy
- Focused Ion Beam
- Real Time Radiology, X-Ray Maps
- C-SAM
- Thermal Imaging
- FTIR
- Scanning Auger
- Atomic Force Microscopy
- SIMS
- Other Tools Including ESD Simulator
- Sample Preparations

#### *Physics of Failure Mechanisms*

- Diffusion - Substitutional, Kirkendall
- Intermetallics - Au Embrittlement, Purple Plague
- Bond wire failures - non stick, intermetallic
- Eight Types of Corrosion - Area effect, and Prevention
- Dendritic Growth, Ag Migration & Electromigration
- Modes of Mechanical Failure
- Fatigue Failure
- Wear

- **Stress-Strain – Yielding, Vibration,**
- **CTE's Mismatch, Thermal Fatigue**
- **Electronic Failure modes from shock, vibration**
- **Creep, Solder Creep, Creep Resistance in Plastics**
- **Organic contamination**
- **Popcorn Cracking, Voiding Delamination**
- **Assembly Errors**
- **Solder Failures (non wetting, grain size, leaching, coverage)**
- **Contamination – Solder non-wetting, Epoxy non-stick**
- **Plating Contamination**
- **RoHS Lead Free Solder Issues**
- **Cu Dissolution**
- **BGA, Tin Whiskers**
- **PCB Finishes**
- **ESD & EOS - Dielectric Breakdown**
- **Current Density & Fusing of Bond wires and wires**
- **Junction Temperature Issues**

### ***Physics of Failure Modeling***

- **Four main types of aging**
- **Engelmaier IPC Solder Joint Life Model, BGAs**
- **Junction Temperature Modeling**
- **Circuit trace and wire bond current density limit modeling**
- **Wear**
- **Creep**
- **Miner' Fatigue Rule (Thermal, Mechanical, Combined)**
- **Transistor Beta Degradation**
- **Transistor FET Degradation**

### ***Physics of Failure measurement techniques***

- **Fatigue Damage Spectrum (FDS)**
- **Mesoscopic Noise Measurements**
- **Parametric Failure Rate Modeling**

### **Enrollment On-Site**

Send purchase order to:

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9510 Centerwood Dr.

Raleigh, NC 27617

Email: [support@dfrosoft.com](mailto:support@dfrosoft.com)

Payment Method by purchase order, paypal or credit card)

For further information, please call Dr. Alec Feinberg at 617-943-9034.

## **On-Site Company Cost Information** (same price as on line for >5 people call or email)

- Two and half day DfRQ course - \$950 Per Person (Min. 4 people or \$3800 payment)
- Note 5 or more people, \$850
- No Extra Cost (i.e. DfRSoft pays for its travel expenses)
- Optional - Design for Reliability & Quality Software \$395 (Free Trial copy included for class)

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- Class Diploma

### **Instructor Information**



**Dr. Alec Feinberg** is the founder of **DfRSoft**. He has a Ph.D. in Physics and is the principal author of the book, *Design for Reliability*. Alec has provided reliability engineering services in all areas of reliability and on numerous products in diverse industries that include solar, thin film power electronics, defense, microelectronics, aerospace, wireless electronics, and automotive electrical systems. He has provided training classes in Design for Reliability & Quality, Shock and Vibration, HALT, Reliability

Growth, Electrostatic Discharge, Dielectric Breakdown, DFMEA and Thermodynamic Reliability Engineering. Alec has presented numerous technical papers and won the 2003 RAMS Alan O. Plait best tutorial award for the topic, “Thermodynamic Reliability Engineering”. Alec has a new book, *Thermodynamic Degradation Science: Physics of Failure, Accelerated Testing, Fatigue, and Reliability Applications* (due out June 2016, with the publisher John Wiley& Sons).