A Preview of the Semiconductor Reliability Short Course

A totally new Semiconductor Reliability Short Course and Handbook has been developed to maximize your productivity by:

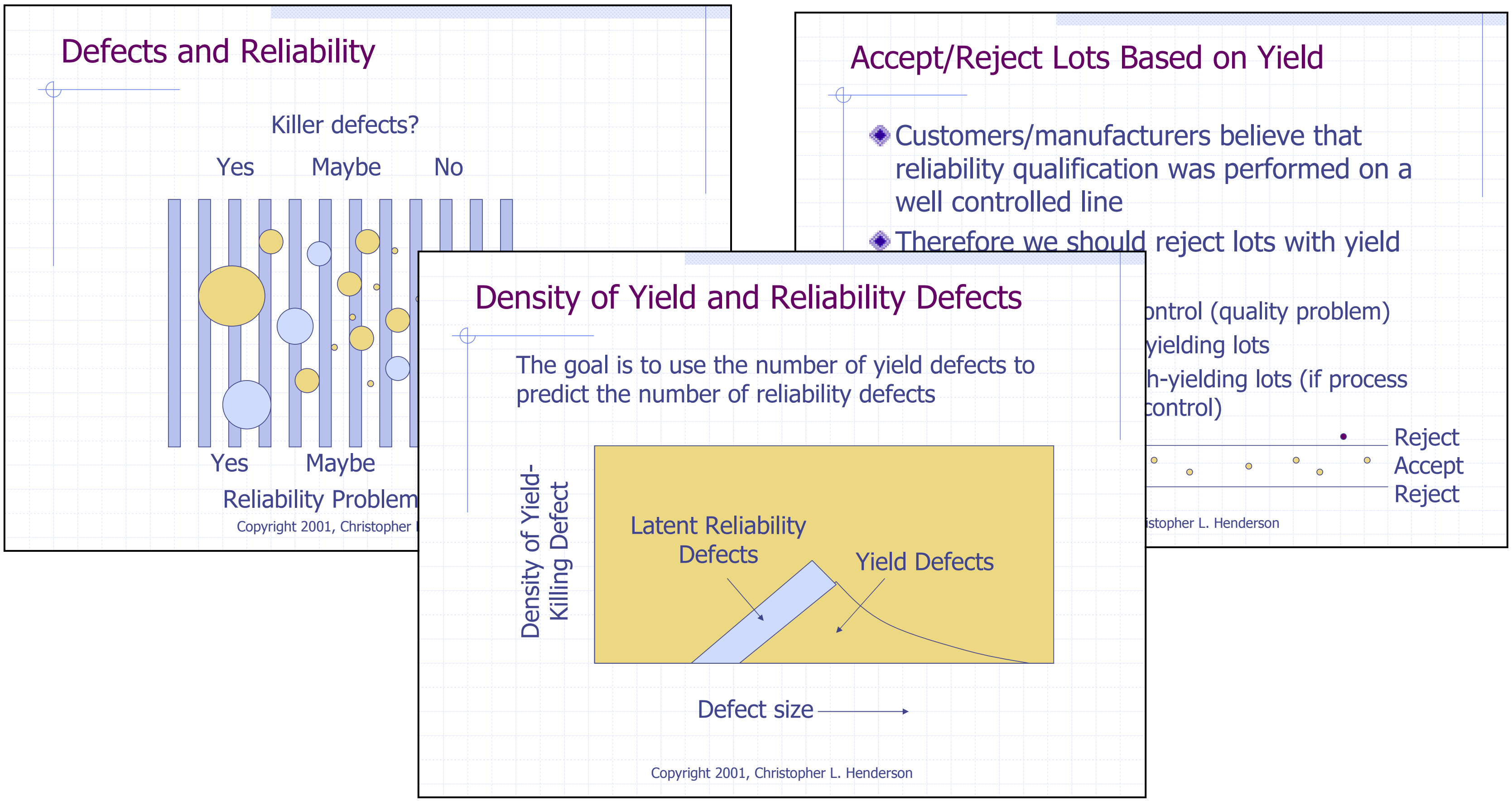
- giving you a general understanding of Semiconductor Reliability
- making it easier to understand the mechanisms that cause complex circuits to degrade
- providing you with the opportunity to learn how to determine the reliability of a component based on its failure mechanisms

The following pages provide an overview of the material typically presented in this unique course. The course is complemented by our 500+ page Handbook and a color CD ROM with a complete, full-color copy of the Handbook and all of the slides presented in the course.

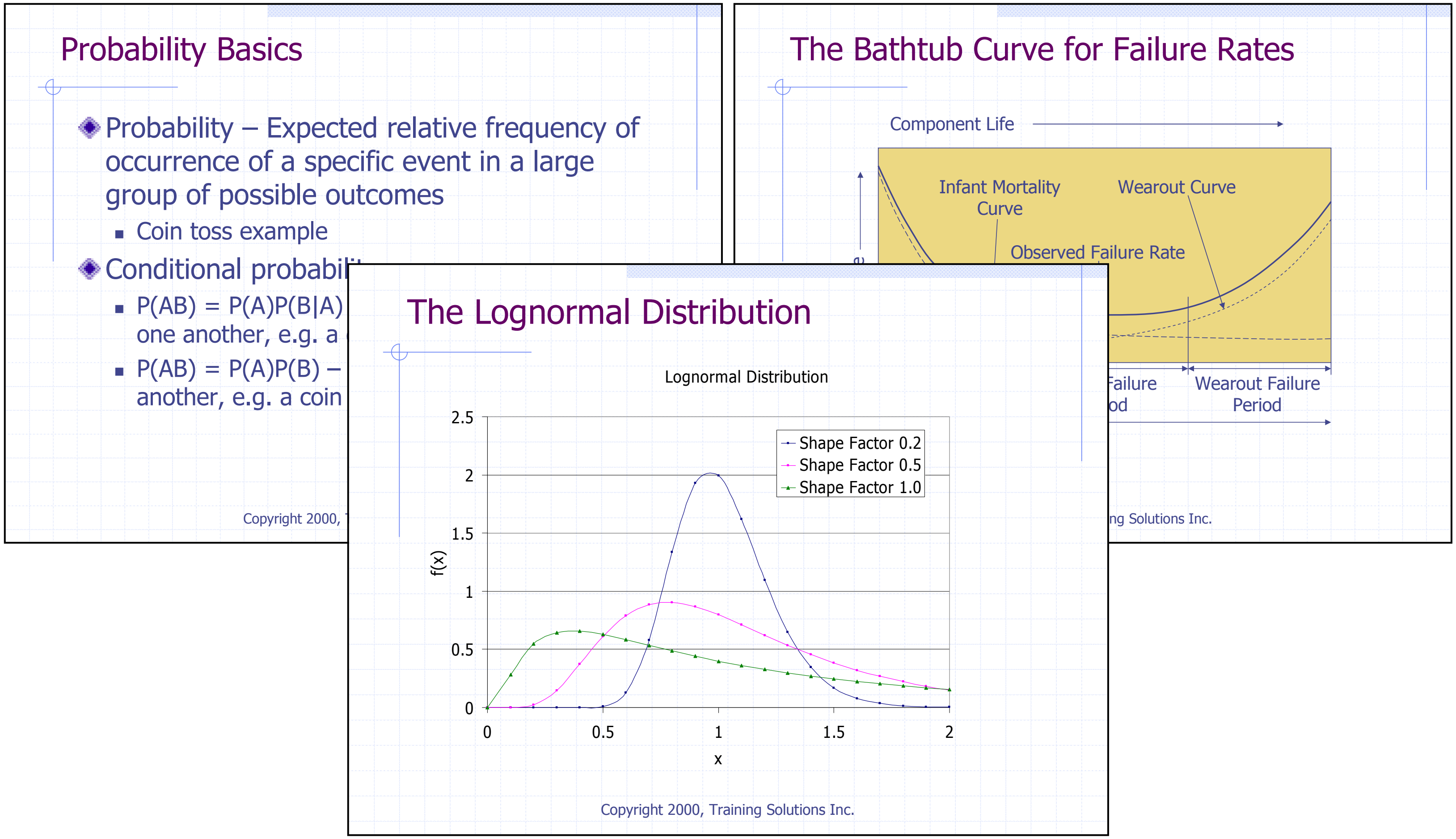
We invite comparison with any other course.

To find the schedule of classes and to register visit www.semitracks.com

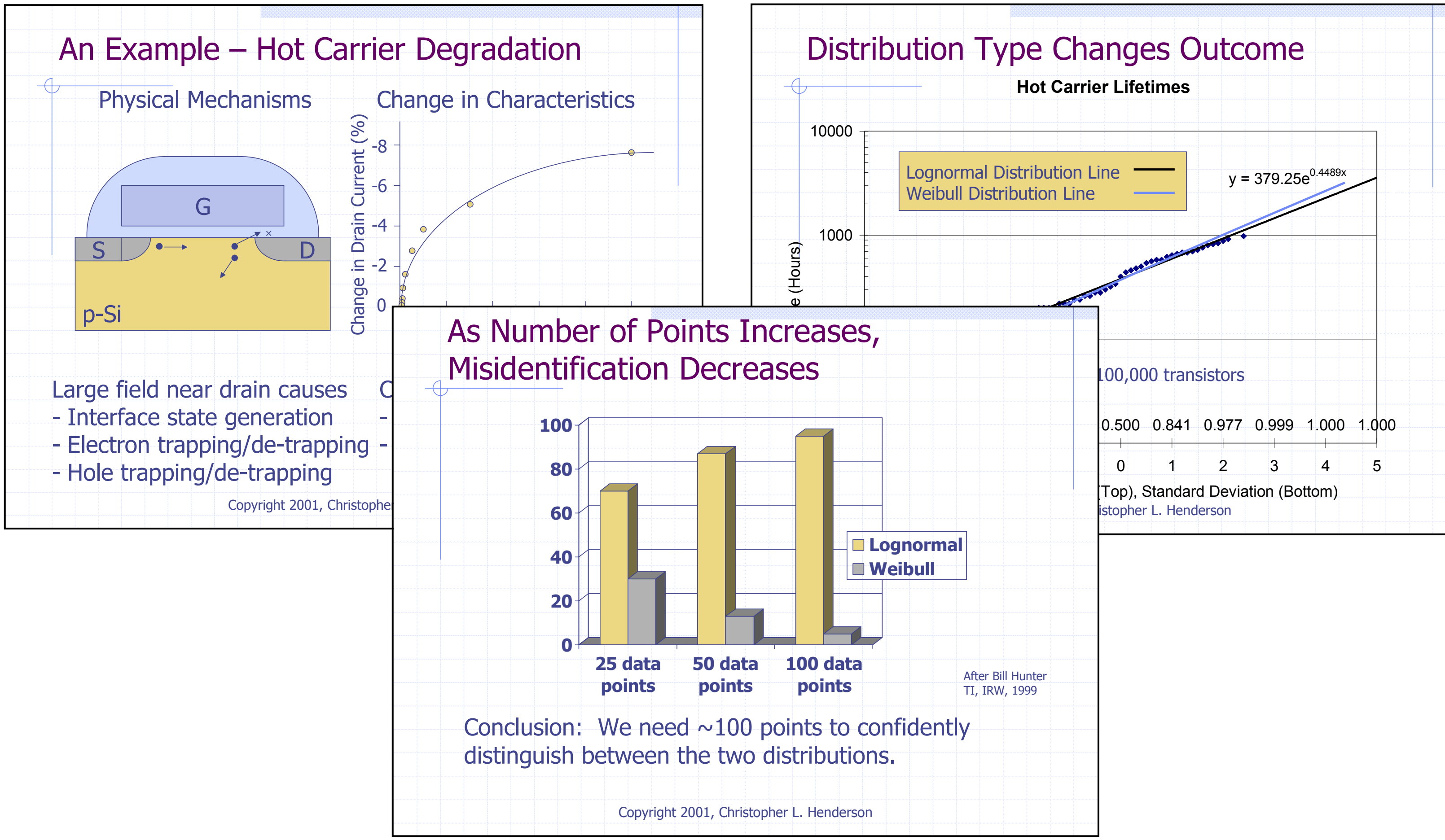
Learn the relationship between yield and reliability



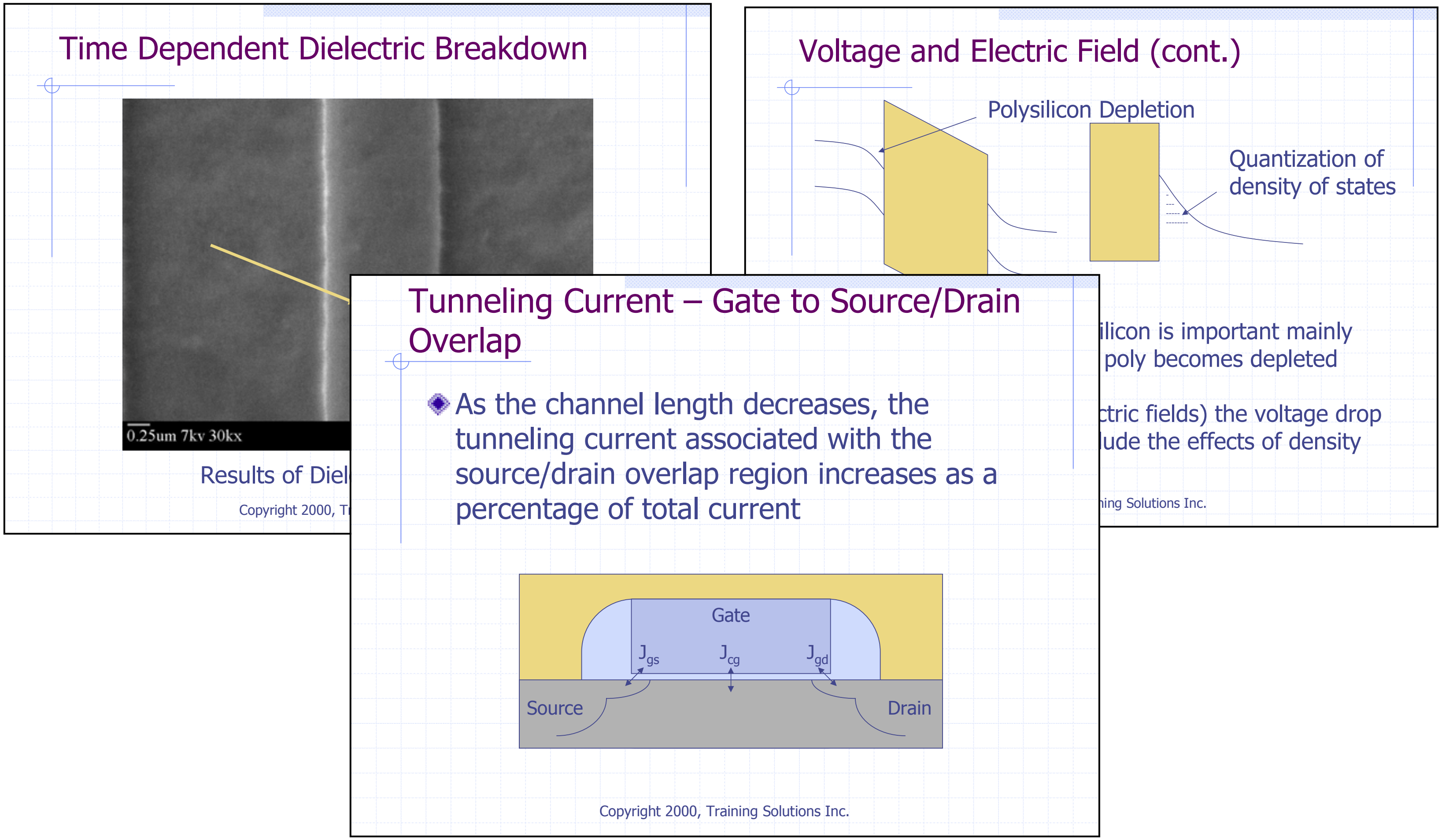
Learn the statistics necessary to understand reliability calculations



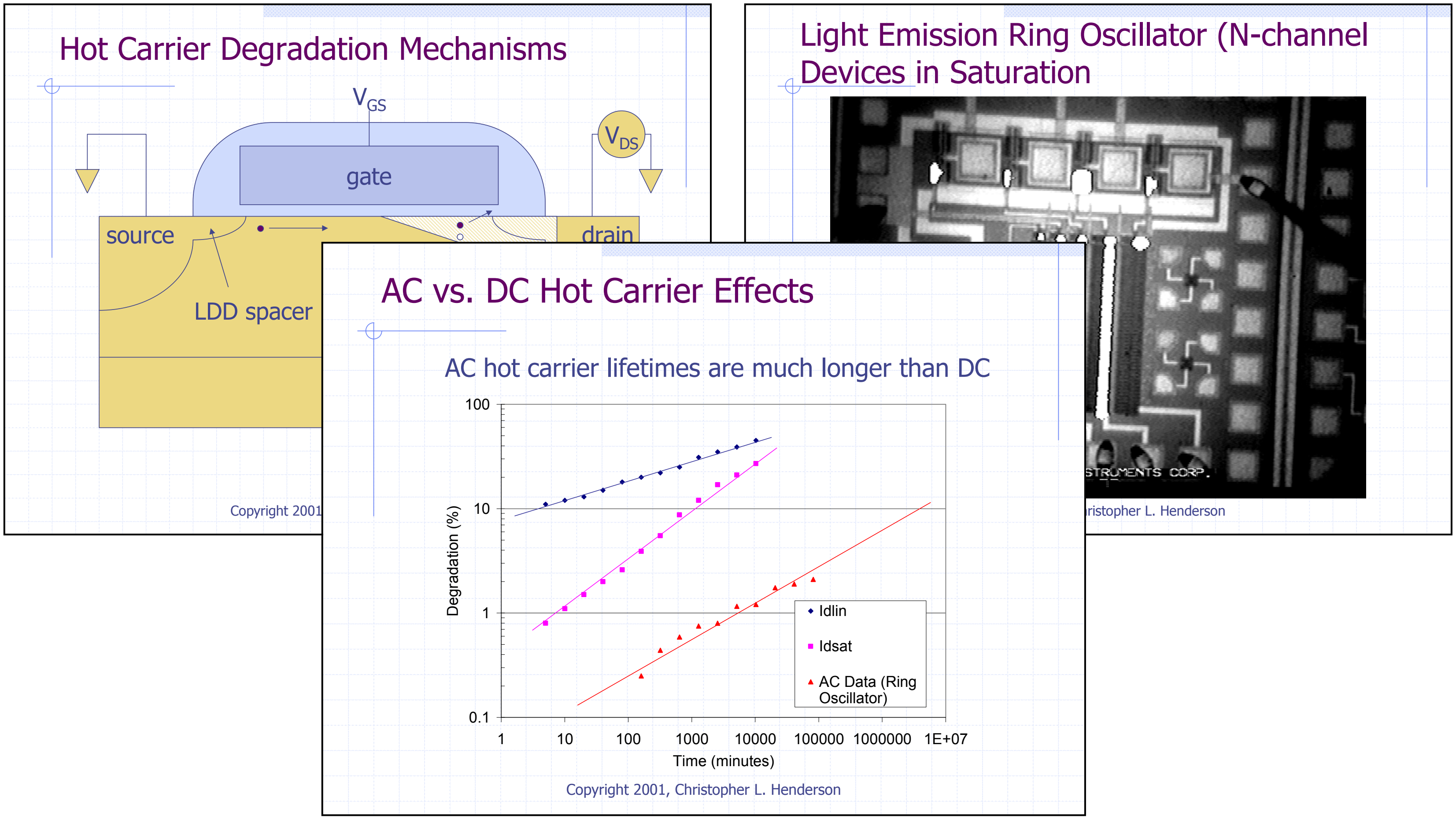
Learn how to use the appropriate distribution for the mechanism



Learn the physics behind Time-Dependent Dielectric Breakdown (TDDB)

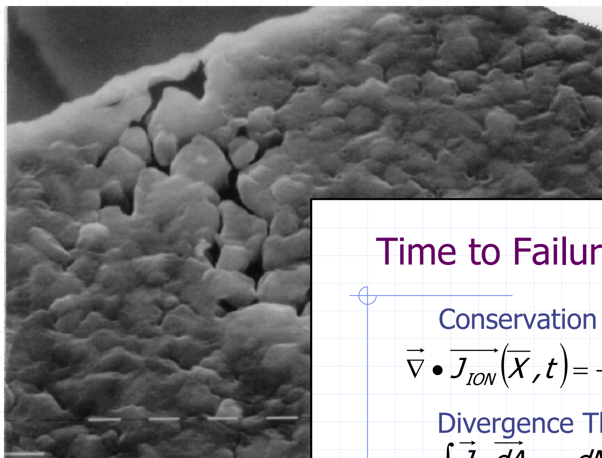


Learn the physics behind Hot Carrier Injection

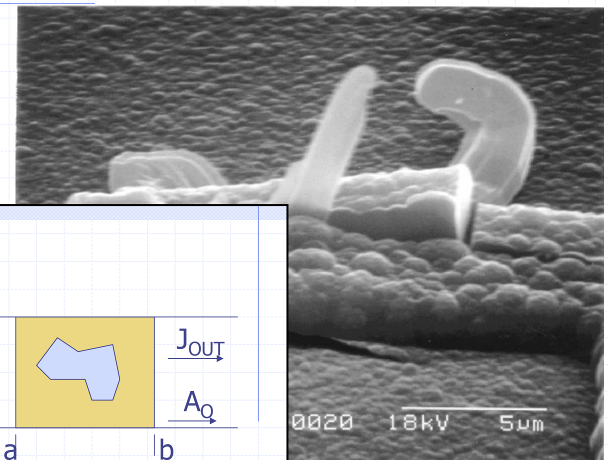


Learn about electromigration and how to prevent it

Electromigration Failure - Open



Electromigration – Metal Extrusion



Time to Failure Equation

Conservation of Mass

$$\vec{\nabla} \bullet \overrightarrow{J_{ION}}\left(\overrightarrow{X},t\right) = -\frac{\partial n(X,t)}{\partial t}$$

J_{IN} A_O J_{OUT} A_O a b

Divergence Theorem

$$\int_A \vec{J}\cdot\overrightarrow{dA} = -dN(t)/dt$$

$$\lambda(t) = -\frac{1}{N(t)}\frac{dN}{dt} = \frac{1}{N(t)}\int_A \vec{J}\cdot\overrightarrow{dA}$$

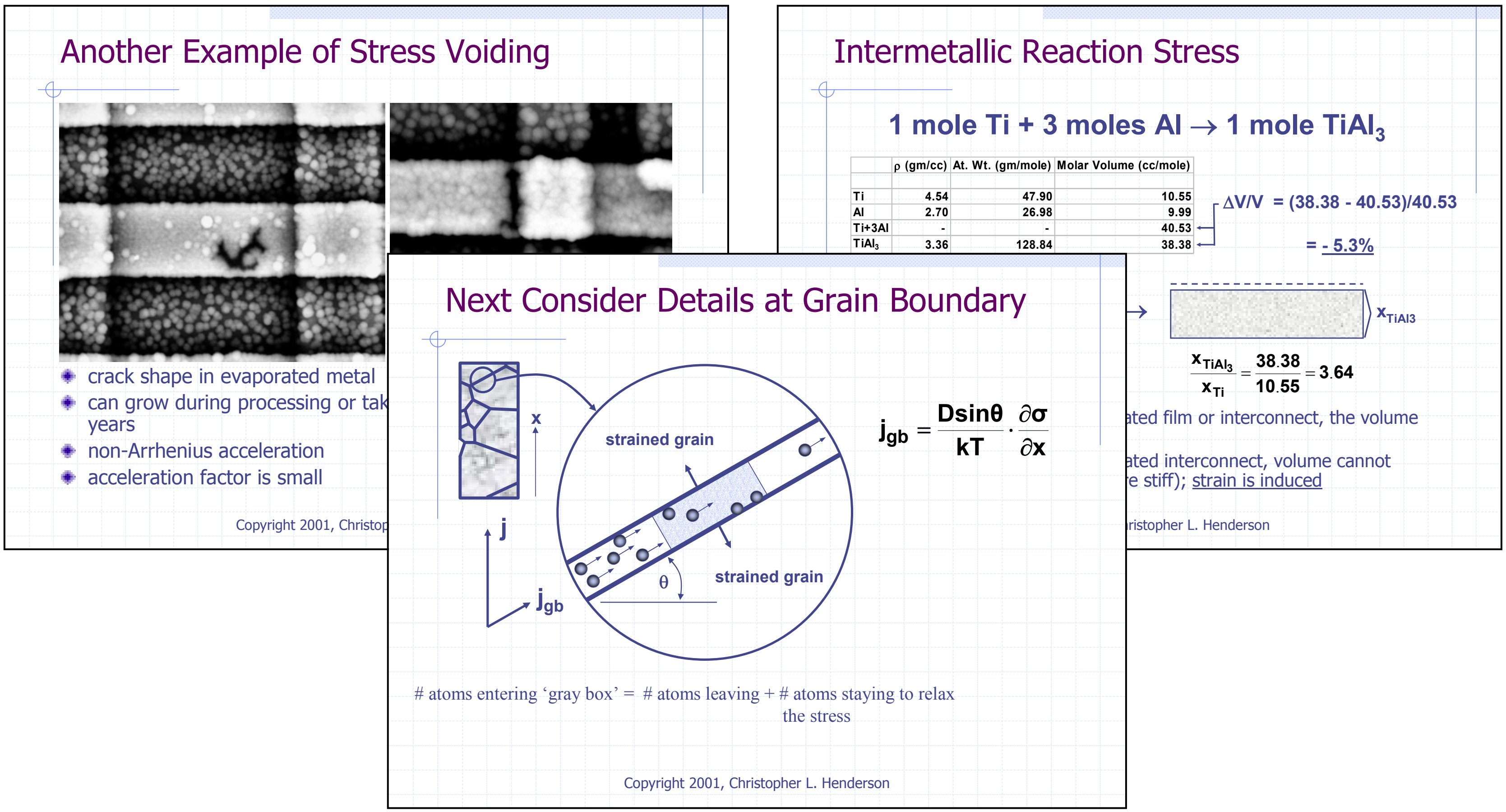
Rate Equation

$$dN/dt = -\lambda(t)\cdot N(t) \qquad \frac{N(t)}{N_O} = exp\left(\int_0^t \lambda(t)dt\right)$$

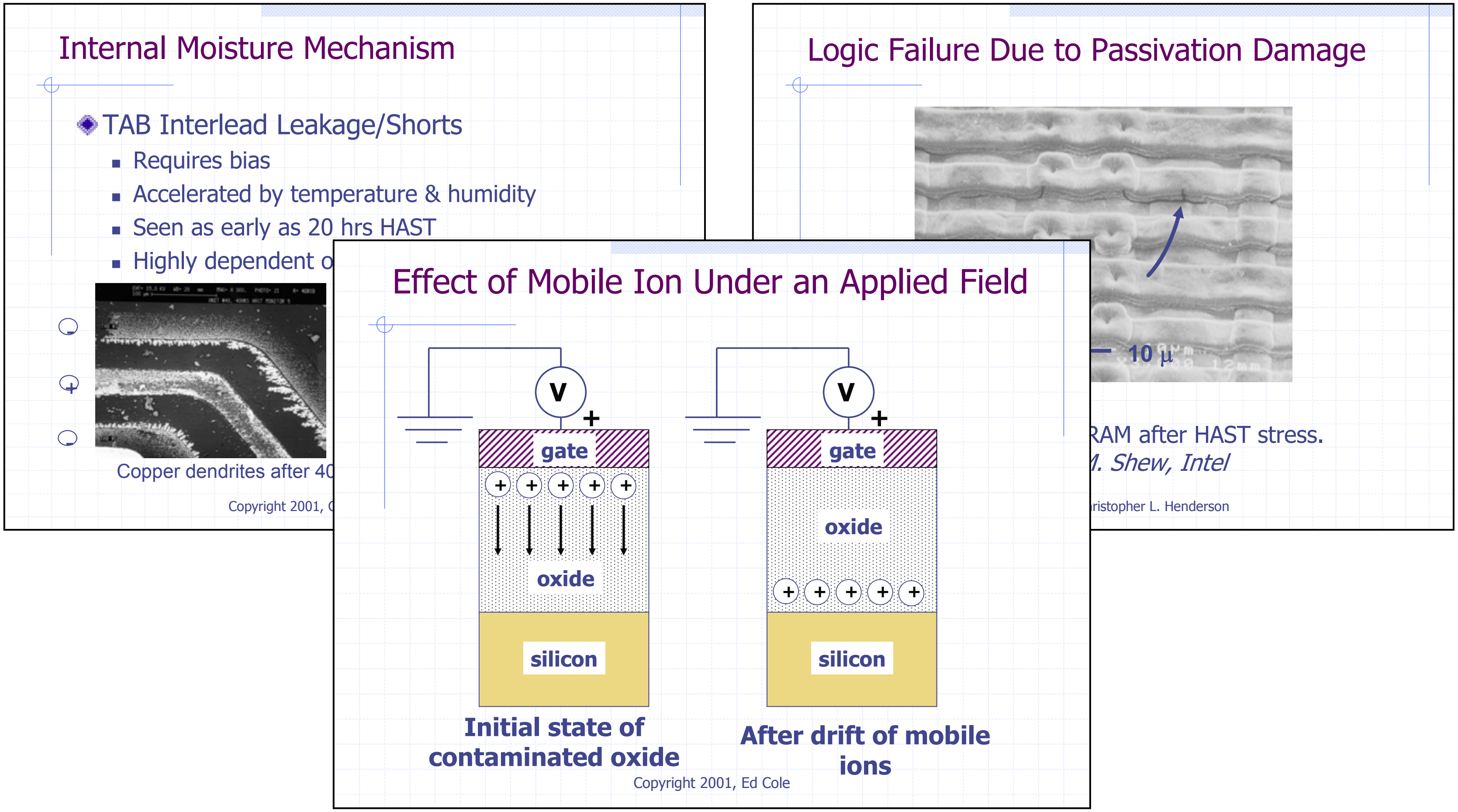
Time-to-failure Equation

$$TTF = \frac{LN(t_{crit})}{\left(\frac{\int \vec{J}\cdot\overrightarrow{dA}}{N(t)}\right)}, \text{ where } t_{crit} = \frac{N(t=0)}{N(t=TTF)}$$

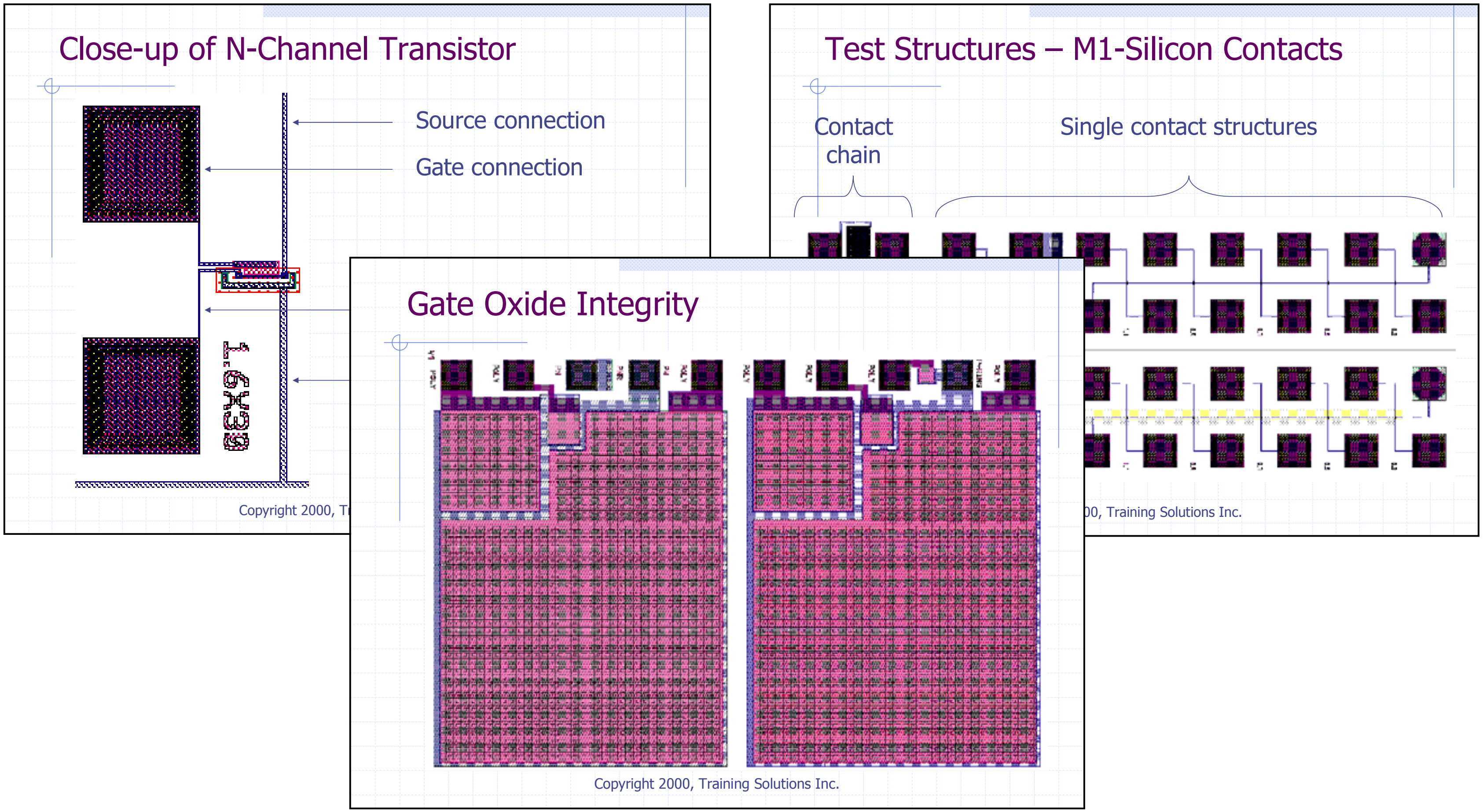
Learn the subtleties surrounding Stress Induced Voiding



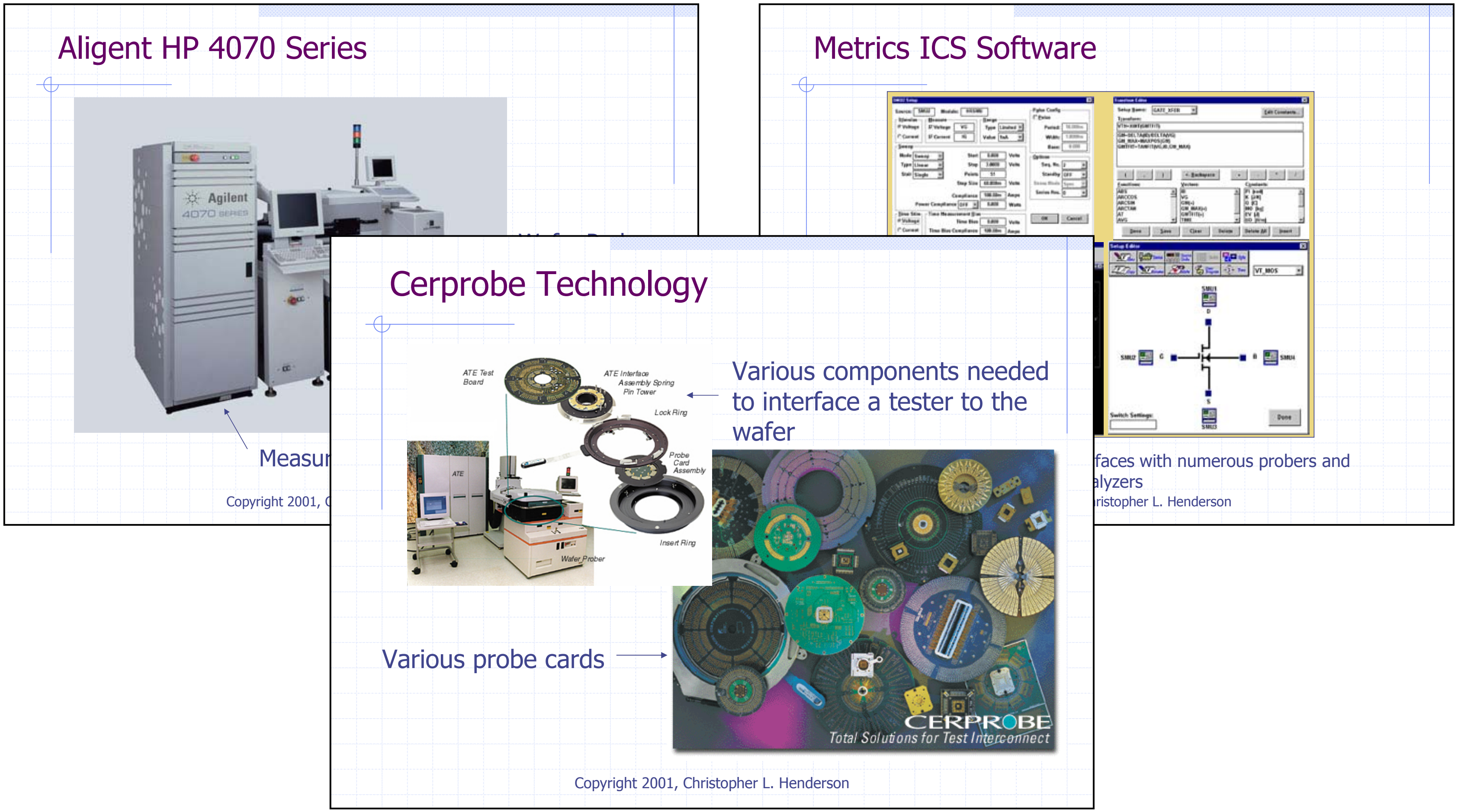
Gain Insight into a Variety of Packaging-Related Failure Mechanisms



Learn How to Use Test Structures to Evaluate Reliability at the Wafer Level



Get Up-to-Date Information on the Latest in Reliability Test Equipment and Software



Make the Correct Decisions When Designing Screens and Burn-In Tests

Burn-In Acceleration Factors

$$MTF = C_o e^{(E_A/kT)}$$

Let's assume an activation energy of 1eV and a stress of 125°C. What is the acceleration in mean time to failure?

$$\frac{MTF_{125}}{MTF_{25}} = \frac{C_o e^{(1eV/8.617\cdot10^{-5}\cdot398}}{C_o e^{(1eV/8.617\cdot10^{-5}\cdot298}}$$

In other words, the sam
to fail at room temperat

Activation Energies for Common Mechanisms

Failure Mechanisms	Activation Energy	Reference
Metal Corrosion	0.3 to 0.6 eV 0.77 to 0.81 eV	Hakim 1989 Peck 1986
Electromigration	0.5 eV (small grained Al) 1.0 eV (large grained Al)	Black 1982 Jensen 1982
Metallization Migration	2.3 eV	Jensen 1982
Stress Induced Voiding	0.4 eV, 1.0-1.4 eV	McPherson 1987, Tezaki 1990
		Amerasekara 1987, Jensen 1982
		Hakim 1989
		Jensen, 1982
		Baglee 1984
		Hokari 1982, Crook 1979, Anolick 1979, McPherson 1985
		Anolick 1979
		Amerasekara 1987
		Hakim 1989, Mizugashira 1985

Arrhenius Type Model for Corrosion

Hallberg and Peck derived an equation to describe the relative life for the corrosion mechanism

$$Re\,lativeLife = (85/RH)^n \cdot exp[(E_A/k)(1/T - 1/358)]$$

Where RH is the relative humdity, n is a constant, EA is the activation energy for metallization corrosion, k is Boltzmann's constant and T is the absolute temperature in kelvin

Relative lifetime with respect to 85/85 conditions