Coupled Thermal-Electrical Transient Analysis of 3D Fuses and Interconnects

Self Heating Effects of Resistive Metals
This presentation covers:

- Transient 3D thermal-electrical analysis in fuses and metal structures
- Benefits are understanding heat generation inside metal structures and heat conduction flow
Generation of a 3D Metal Structure for Thermal-Electrical Analysis

Wiring Structure.

2-D cross sectional view.

Materials:
- Conductor
- Silicon
- Tungsten
- SiO2
- Aluminum
- Si3N4
- Copper
Generation of a 3D Metal Structure for Thermal-Electrical Analysis

Victory Cell is used to create the 3D structure.
Victory Cell is used to generate the 3D tetrahedral mesh generation.
Transient Analysis of Metal Self Heating

Drain Voltage

Drain Current

Time-dependence of drain voltage and current.
• Victory Device solves the 3D coupled thermal-electrical transient analysis.

Lattice temperature versus transient time.
Transient Analysis of Metal Self Heating

Potential at $t = 100\text{ns}$

Potential at $t = 200\text{ns}$
Log(10) of Current Density at T = 100ns.
Transient Analysis of Metal Self Heating

Joule Heating Power at $t = 100\text{ns}$.
Transient Analysis of Metal Self Heating

Lattice Temperature at $t=100\text{ns}$.
Power turns off at this point.

Thermal conduction continues even beyond this 200\text{ns}.
This presentation demonstrates:

- Creation of a 3D wiring structure using Victory Cell
- Tetrahedral mesh generation required for arbitrary shaped 3D structures
- Self heating simulation capability for metals as well as semiconductors using Victory Device
- Coupled 3D Thermal-Electrical transient analysis using Victory Device