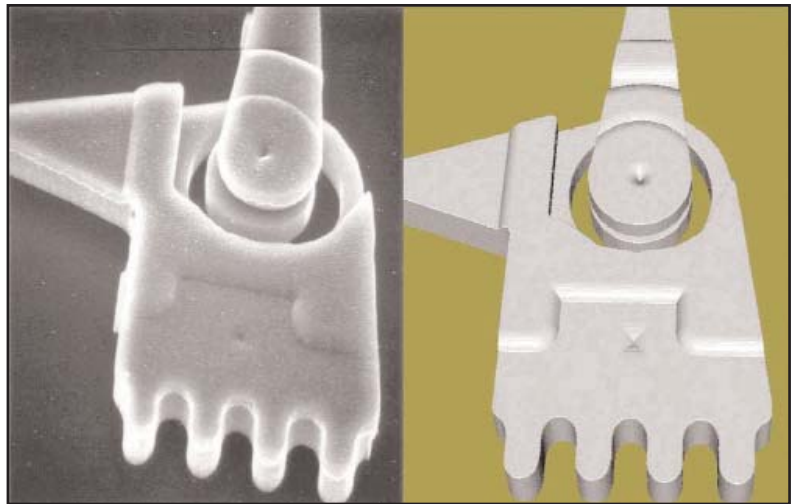


MEMulator™ from Coventor, Inc.

- Provides highly detailed, realistic looking 3D geometry models of micro-fabricated devices.
- Customizable to any type of semiconductor fabrication process used for making MEMS, ICs and disk-drive heads.
- Efficiently and robustly captures a wide range of geometry, from submicron-scale details to whole dies.
- Enhances communication between process engineers and non-specialists inside the fab, and with the fab's customers.
- Speeds diagnosis of design flaws, and yield and reliability issues.

MEMulator for MEMS and Semiconductor Processes

MEMulator is a new software product that simulates the semiconductor fabrication techniques used to manufacture MEMS, ICs, disk-drive heads and flat-panel displays. Starting from a 2D layout and a fabrication process ("technology") description, MEMulator uses a patented voxel-based algorithm to produce a detailed, realistic-looking 3D geometry model. MEMulator models can be visualized in 3D or exported to 3rd party CAD tools and 3D field solvers. MEMulator is a valuable tool for developing new fab processes, refining existing processes, communicating within a fab and to its customers, and for diagnosing yield and reliability issues.



Comparison with SEM image (left) with a MEMulator 3D image (right)

Supported Fabrication / Process Steps

Material Addition Steps:

- Physical Vapor Deposition such as evaporation, sputtering, etc.
- Chemical Vapor Deposition such as LPCVD and PECVD
- Conformal Deposition - isotropic material deposition on all surfaces
- Metal Lift-Off Deposition - anisotropic deposition
- Epitaxial Deposition - anisotropic deposition on epi silicon substrates
- "Snow-fall" Deposition
- Straight Deposition - material deposition only on horizontal faces to simplify the geometry
- Wafer Bonding - emulates wafer bonding steps
- Electrochemical Deposition

Defect Detection:

- Void detection, tracking and filling: checks for voids after partial and oval deposition steps
- Study the effects of mask misalignments and other process deviations
- Air pocket detection
- Prevent backfilling of cavity voids

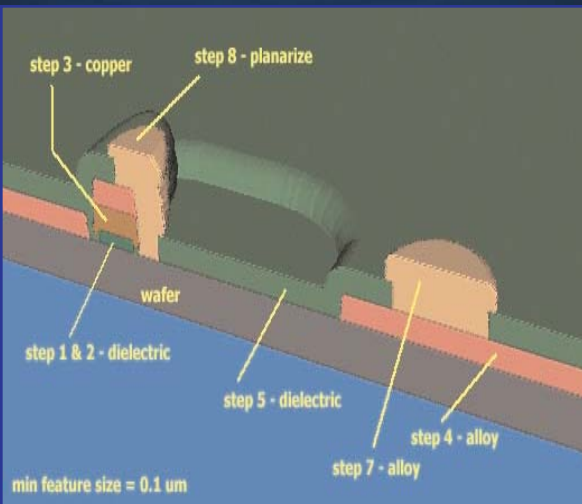
Material Removal Steps:

- Reactive Ion Etch (RIE) - Straight etch through specified thickness
- Wet Release Etch - timed release etch by undercutting sacrificial layer
- Wet Isotropic Etch - bulk micro-machining process step for creating rounded features
- Wet Anisotropic Etch - bulk micro-machining process step for creating angled side walls
- Chemical Mechanical Polish - removes material above a specified height

Additional Fabrication Features:

- Multiple protective etch stops
- Etch the top, bottom, or both sides of a wafer
- Perform multiple etches with different masks on a single wafer
- Determine the effects of vertical etching coupled with anisotropic etching
- Find and replace materials

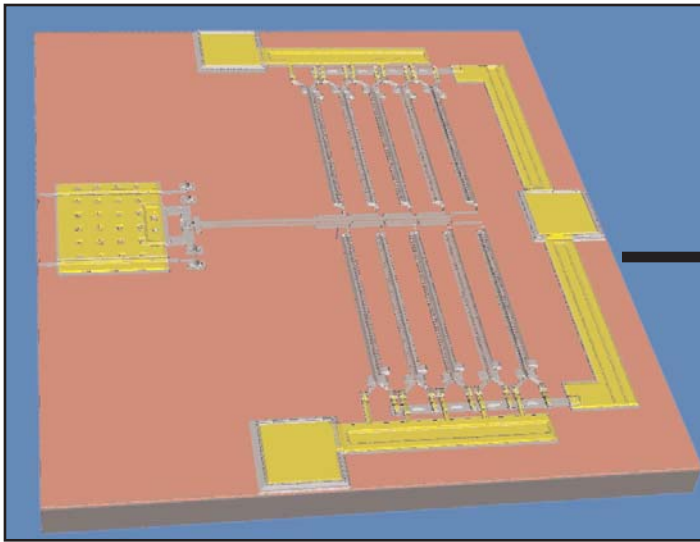
Is your process step or sequence not listed?
MEMulator let's you program your own process step



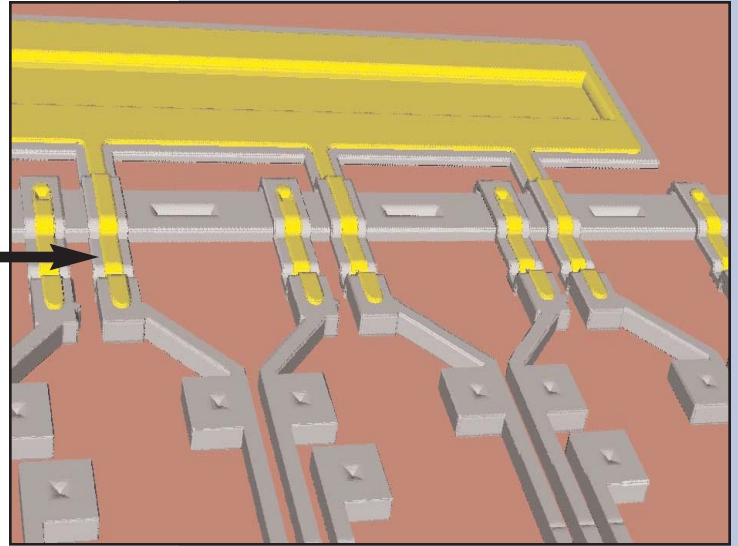
COVENTOR™

WHAT'S NEXT. AND NEXT. AND NEXT.™

Scalable 3D Visualization



MEMulator handles a wide range of length scales



MEMulator Features

Mask Operations:

- Input from GDSII format
- Supports Boolean operations (Add, Subtract, Complement, Union, Offset, and Inset operations) directly on the mask information without a need to return to the layout tool
- Completely robust to mask defects
- Masks may be specified during deposit for patterning

Micro-assembly:

- Simulate micro-assembly procedures
- Segment and manipulate mechanical and electrical components individually
- Find design errors caused by merged parts, improper connections, and stringers
- Verify electrical connectivity and identify electrical shorts
- Translate / Rotate geometry along distance and axis dimensions

Scripting Language:

- Includes "Python" based scripting
- Parameterized arguments supported
- Used to set up process steps and post process visualization

Visualization:

- Interactive visualization
- 3D cross sectioning, pan, rotate, zoom, and resizing supported
- Quick rendering of the die or whole wafer in one step
- 3D export to DXF and STL formats

Meshing (Optional):

Automatic surface meshing

- Triangle-only meshes
- Mixed-element meshes
- Output in UNV and ANSYS formats

Automatic volume meshing

- Tetrahedral-only meshes
- Mixed-element meshes (Tets, Pyramids, Prisms, & Hex elements)
- Export to ANSYS, ESI-CFD, DTF and SDRG UNV formats

Mesh controls

- Local and global tolerance control
- Local and global edge-length control
- Local mesh refinement

Platform Support:

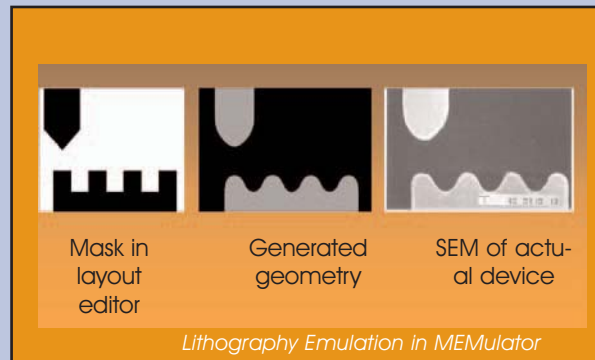
- Windows 2000 and Windows XP
- Open GL video card required

Coventor Products

CoventorWare is ideal for developing MEMS and microsystems for an unlimited variety of applications including optical communications, RF/wireless communications, biotechnology, automotive, and sensors

- **ARCHITECT:** Multi-domain technology simulator for device, component or system level products including physical models, control models and Electronics
- **DESIGNER:** MEMS device construction tool; generates 2-D mask layouts and 3-D solid models; includes material property database, process editor and import/export capabilities
- **ANALYZER:** Group of field solvers for detailed physical analysis requiring thermoelectromechanics, optics, fluidics, electromagnetics, and more
- **INTEGRATOR:** Tools to extract detailed design-specific behavioral models from Finite Element straight into Saber, Cadence or Matlab-Simulink
- **MEMulator™:** A versatile virtual prototyping tool used to emulate complex MEMS processes
- **Etch3D™:** A 3D simulator for anisotropically etching Silicon in any orientation with etchants such as KOH, TMAH, and others

Add Etch3D - the anisotropic wet etch simulator for silicon. This simulation engine is 100% compatible with all MEMulator features.



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