# RECIPE – RIE/ICP Etch Simulator

## RIE, ICP and Bosch™ DRIE Etch simulator for MEMS and ICs

## RECIPE for success

RECIPE is a powerful, easy-to-use RIE/ICP (Reactive Ion Etch/Inductive Coupled Plasma) etch process simulation tool for use in designing microstructures. With RECIPE, you can layout your microstructure and automatically simulate isotropic, RIE, ICP/Bosch/DRIE etching or any combination of the three processes.

RECIPE simulates both ion-assisted etching and deposition processes. In fact, it is the only tool on the market for simulating the deep etching of silicon and other substrates.!

## Easy setup

IntelliSense recognizes that differences in etch systems can cause a large variance between any simulation and experimental results. In order to minimize these differences, simple setup methodology is provided to calibrate RECIPE models with your etch machines.

## Sequential multiple etches

RECIPE allows you to explore novel structures and allows you to tailor your cross sections on a PC, rather than performing cumbersome and costly clean room experimentation. For instance, you can easily perform an anisotropic RIE etch, an isotropic etch and a Bosch etch — one right after another! In addition, you can use an isotropic etch to explore front-side release of structures.

## Powerful capabilities

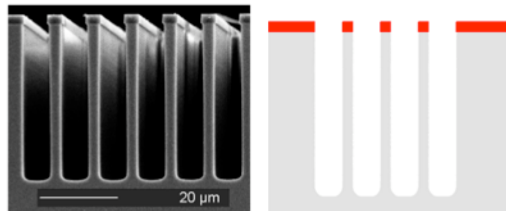
RECIPE was designed for process and design engineers to help predict the effects of real world etch phenomenon. RECIPE can be used to predict variable etch rates and RIE lag phenomenon, sidewall angles, notching and pinch-off effects and sidewall scalloping. By combining isotropic and anisotropic and DRIE processing, you can quickly design complex structures such as bowl and stem structures to increase sidewall coverage or other customized sidewall profiles.

RECIPE will save you both time and money by reducing the number of fab trials.

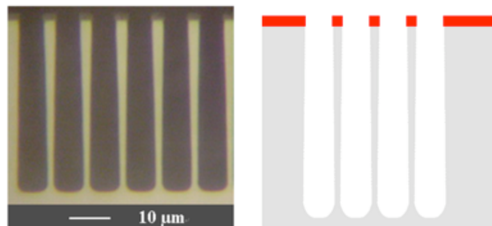
# Feature highlights

RECIPE offers you the ability to simulate a variety of RIE/ICP-related effects. These include:

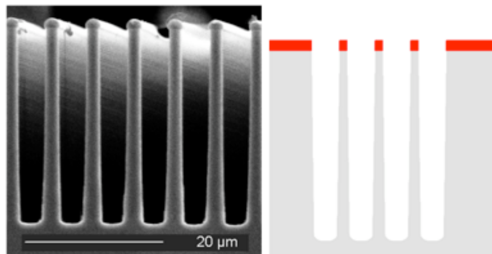
- Predict sidewall scalloping roughness and periodicity
- Predict final dimensions and shape of features
- Predict sidewall angles
- Simulation of RIE lag. You can estimate how much quicker larger features etch compared to smaller features as a function of process parameters
- Positive angle or negative (retrograde) etching
- RIE notching and etch termination (pinch-off) behavior
- Front-side release processes in SOI based processes
- Bowl and stem etches (combination of isotropic and anisotropic etching) to form wine glass shapes for improved step coverage
- Release prediction: isotropic release of plates for poly-silicon-based MEMS
- Trench refill and trench isolation simulation for high-voltage circuits
- Angled etching of substrates



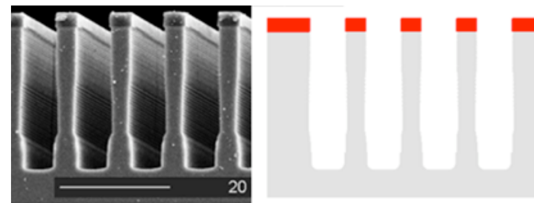

The experimental results of the etching. Comparison of etching 5 µm openings with an etch/dep cycle of 7s/7s.



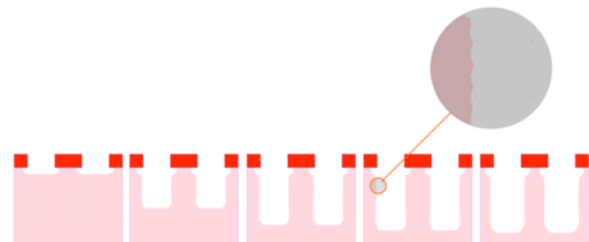

Comparison of etching a 5 µm trench with a 7s/8s cycle



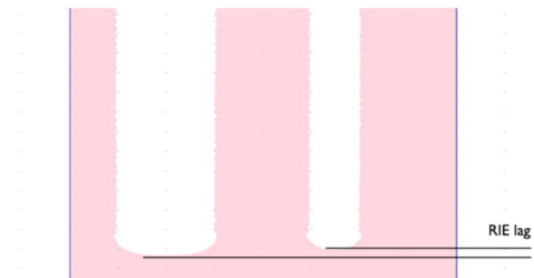

Comparison of etching a 5 µm trench with a 5s/7s cycle




The experimental result of the etching of trenches using three etching steps with different etching/polymerization time configurations. 7s/7s, 9s/7s and 5s/7s are used sequentially, each for 5 minutes.



Progression of an etch featuring three processes: 1. Isotropic RIE to create a wine bowl 2. Bosch etch (DRIE) to create the wine stem and 3 Isotropic RIE to smooth the scalloping and improve sidewall coverage. Inset shows the detail of the sidewall scalloping.




Determine RIE etch lag and etch termination (pinch-off). Smaller features etch slower than larger features.

IntelliSense Software

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