MEMS in EE143

Why are MEMS being incorporated into the EE143 mask set?

Because MEMS constitute a growing field which has spawned from the robust and widespread microfabrication industry. Many traditional integrated circuit corporations are now investing significant research dollars in MEMS. Products are already in the market and many others are in development.

Four MEMS structure have been added to the EE143 mask set: A thermal bimorph actuator, a heat platform, a cantilever, and a campanile. These four are intended to be representative of the types of structures being used by the MEMS community. The only additional process step needed is the XeF2 etching step after Al patterning.

Thermal Bimorph

Cantilevers

Campanile

Heat Platform

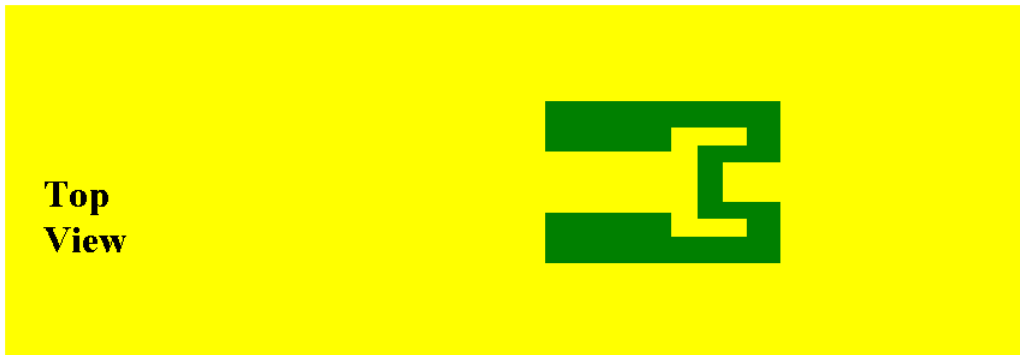
Process Flow of Thermal Bimorph Actuator

* Schematic Top-Views and Cross-sections
are not drawn to scale

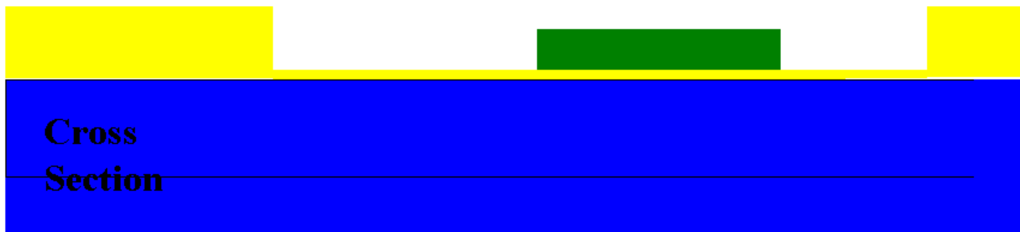
After Patterning Field Oxide (Mask #1)

Aluminum Poly Si Oxide Si substrate Al-Poly contact

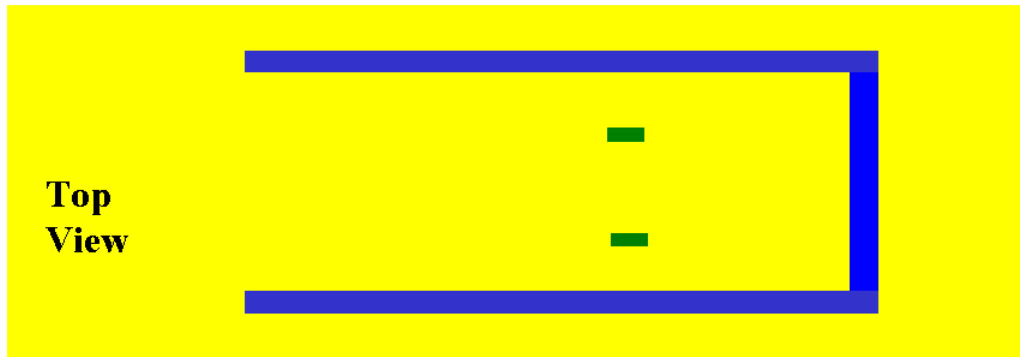
After Patterning Poly-Si (Mask #2)



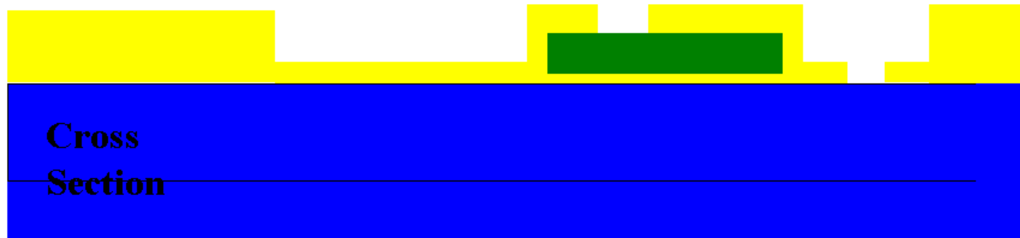
Aluminum Poly Si Oxide Si substrate Al-Poly contact



After Patterning Intermediate Oxide (Mask #3, Contact-Hole Cut)



Aluminum Poly Si Oxide Si substrate Al-Poly contact



After Aluminum patterning (Mask #4)

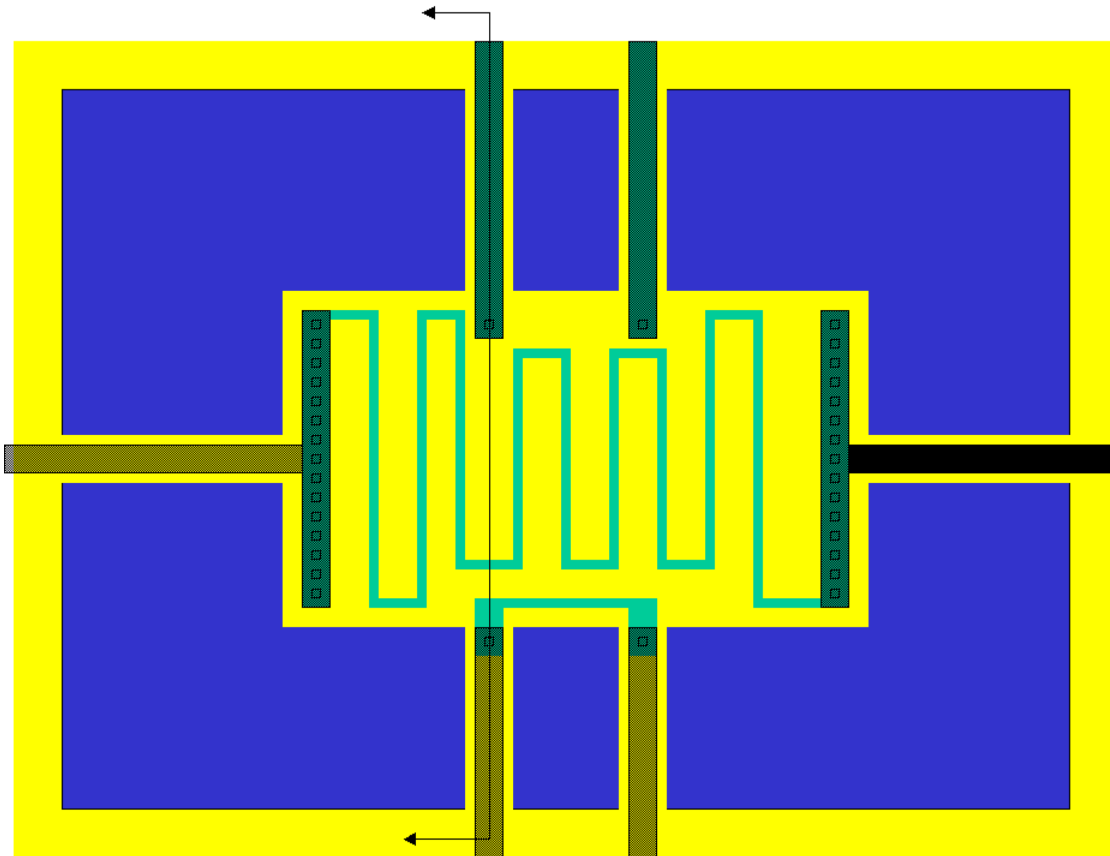
After XeF2 selective etching (Final Structure)

Process Flow of Heat Platform

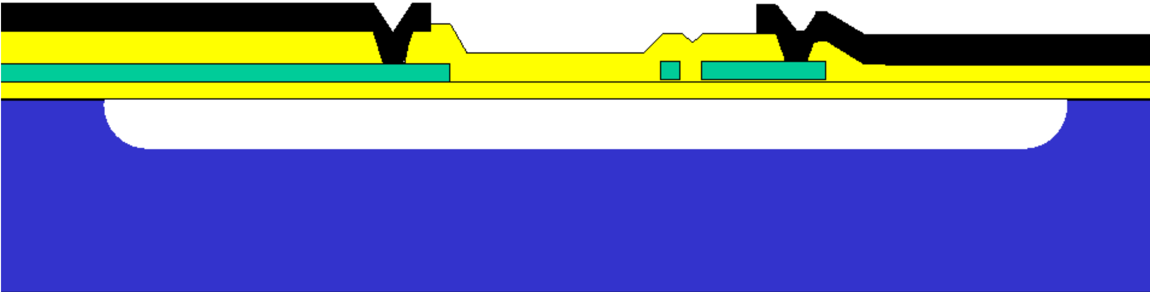
* Schematic Top-Views and Cross-sections
are not drawn to scale

The platform is well isolated from the substrate. Heat is applied to the platform using a resistive heater and measured using the thermopile and the thermoresistor. This device could be used as AC→ RMS converter.

Top view of the Heat Platform



Cross-section of the Heat Platform



Process Flow of Cantilevers

* Schematic Top-Views and Cross-sections
are not drawn to scale

This device will allow you to see how a strain gauge works, and it will also introduce you to the concept of resonant frequency.

Cross- sections through the process flow…..

Field Ox & Pattern

Gate Ox & Poly Dep

Poly Etch
Gate Ox Etch

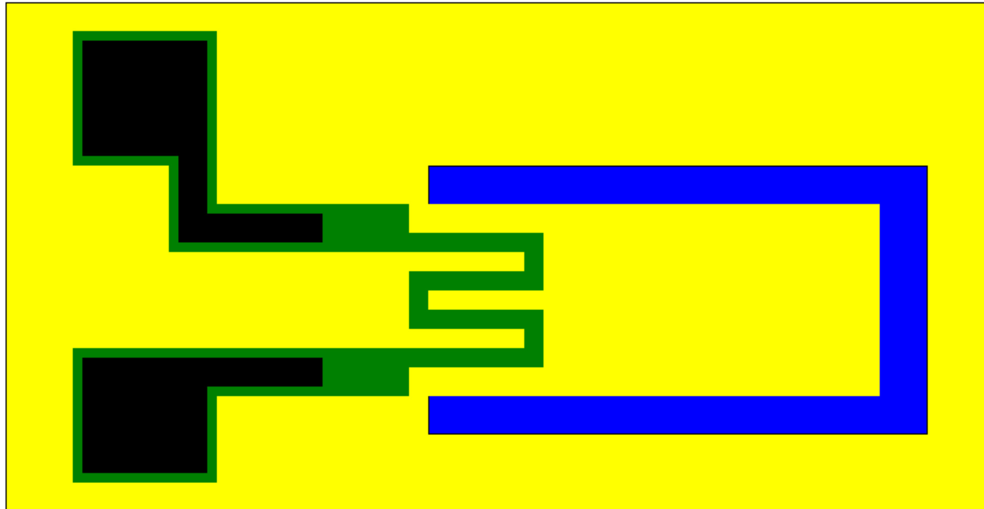
Cross-sections through the process flow….

Intermediate Ox
Contact Pattern

Al dep and pattern
Not in this cross-section

XeF_2 etch

Top View of completed structure



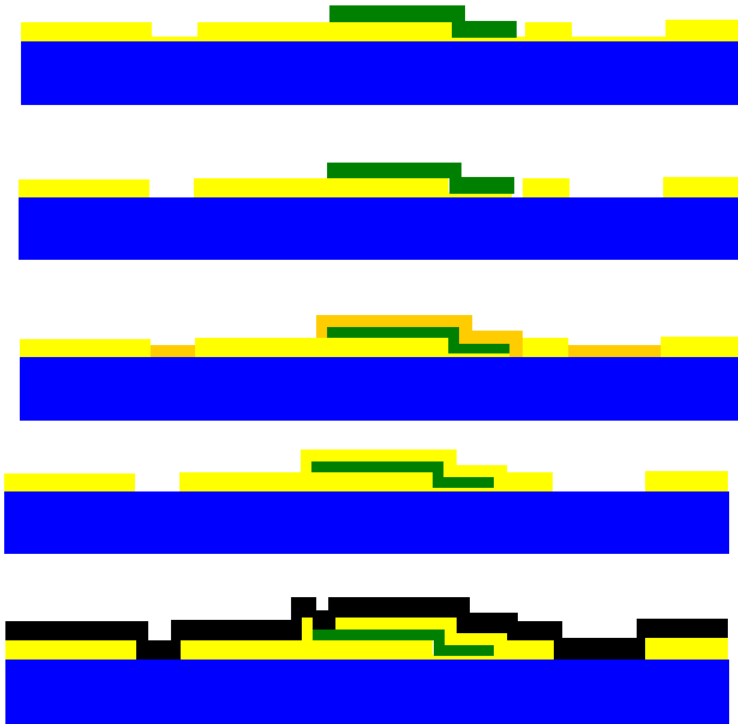
Process Flow of Campanile

* Schematic Top-Views and Cross-sections
are not drawn to scale

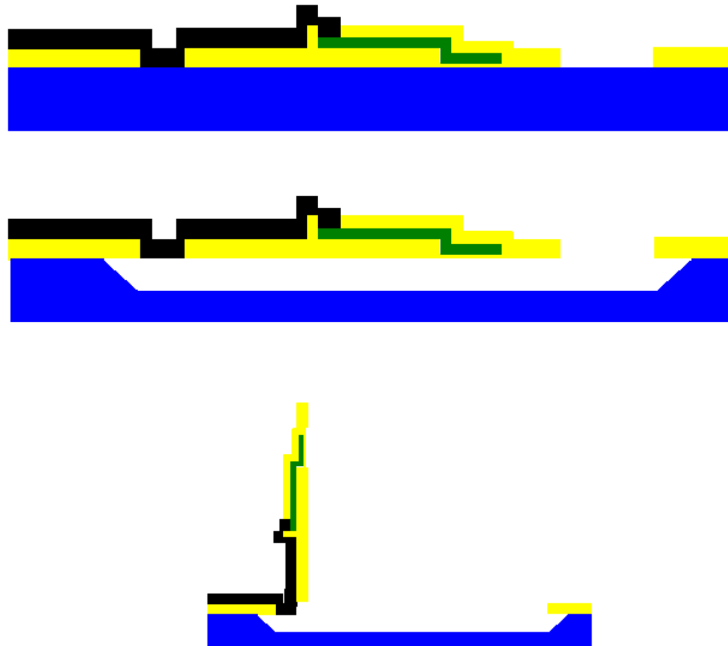
This will allow you to see an example of a "pop up" structure, and give you a feel for how materials behave at these small scales. The structure consists of three plates--the campanile, and two side plates to align the campanile (not working, unfortunately, on the present mask set). To assemble, slide a probe tip under the tip of the campanile. Lift and carefully move the probe tip toward the hinges in very small increments. You will hopefully be able to recognize some of the features of the campanile.

Deposit and pattern field oxide, grow gate oxide, deposit polysilicon

Pattern polysilicon, remove gate oxide, deposit and pattern intermediate oxide, evaporate aluminum.



Pattern aluminum, remove silicon substrate with XeF_2 etch, complete campanile lift with probe tip.



Top view of campanile