

EE/CprE/SE 491 Weekly Status Report 7

Dates: 3/5/18 – 3/9/18

Group #: 5

Project: Micro-Electro-Mechanical Systems (MEMS) Based Sensing System for Soil Conditions Monitoring

Client: Dr. Halil Ceylan

Advisor(s): Shuo Yang and Dr. Yang Zhang

Team Members:

Nathan Coonrod (Report Manager)

Kyle Kehoe (Communications Manager)

Jacob Verheyen (Meeting Facilitator)

David Severson (Web Master)

Sok-Yan Poon (Timeline Manager)

Weekly Summary

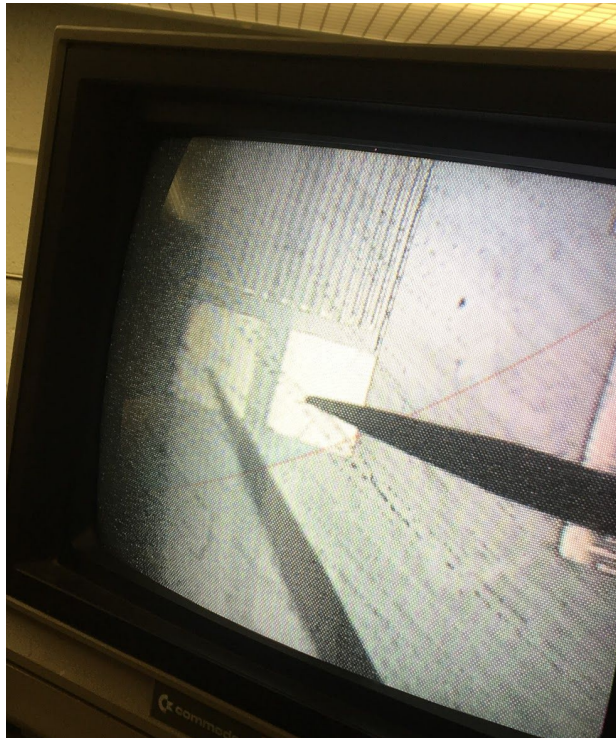
Our team's goal for this week was to test and document the functionality of the provided MEMS temperature and moisture sensors to verify which sensors we wanted to have cut from the wafers and use in our prototype. Members of our team went out to the Microelectronics Research Center (MRC) at Iowa State to meet with Dr. Tuttle and test the sensors. I summarize the testing procedure we utilized with the assistance of Dr. Tuttle below:

1. Used a wafer probe station and parameter analyzer to obtain a resistance value for a temperature sensor.
2. Used a microscope to verify dimensions of a capacitive moisture sensor.

We would have ideally liked to test every sensor on the wafers provided but this would have taken too long. In addition, based on our observations, we have deemed the sensors not functional and very difficult to work with. The results are summarized below:

1. By attempting to use a wafer probe station and parameter analyzer, we found that proper contact could not be made with the pads of the sensors and the leads of the equipment we were using. There may be some sort of material on top of the sensors that is preventing proper contact from being made. We checked the test equipment was working properly by performing a successful short-circuit test.

2. By using a microscope, we attempted to verify the dimensions of a capacitive moisture sensor. We measured an approximate spacing of 59 μm . There was no external display to document any images of the capacitive moisture sensors, but we found that a moisture sensor was heavily damaged and scratched and inferred that most if not all of the other sensors are in a similar condition.
3. A picture of the sensors being tested with the needle-like probes is shown below. You can see the obvious imperfections in this resistor, and although we forgot to take a picture under the high-definition microscope, we think this tells the story well enough.



Past Week Accomplishments

- Kyle: Assisted with functionality testing of MEMS sensors, prepared meeting documents/agendas, and reported results of sensor testing.
- Nathan: Assisted with functionality testing of MEMS sensors at MRC, additional assembly of prototype.
- Jacob: Continued researching temperature and humidity sensor technology.
- David: Set up wafer testing with Dr. Tuttle and drove the team to the MRC. Continued with building simulations for capacitance measurement.
- Sok-Yan: Updated timeline, researched temperature and humidity sensor technology.

Pending Issues

The smaller version of the MEMS sensors were both very difficult to interface with and heavily scratched. If the data acquisition system is to utilize specially developed MEMS sensors, they will need to be recreated.

Speaking with Dr. Tuttle, our understanding is that these sensors could be recreated if the appropriate design/schematic files are provided and the lithographic mask that was used when these sensors were fabricated on a wafer initially. This fabrication could be done at the MRC again assuming the appropriate resources (schematic files, mask, and financial) are provided.

Wafers are created at the MRC very often, and if the sensors are as simple as they were explained to be in our meeting with the developer, this wouldn't be a huge issue to recreate them.

Individual Contributions

Name	Contribution	Hours This Week	Hours Cumulative
Kyle	Assisted with functionality testing of MEMS sensors, prepared meeting documents/agendas, and reported results of sensor testing.	4	28
Nathan	Assisted with functionality testing of MEMS sensors, additional work on prototype assembly	3	28
Jacob	Continued researching temperature and humidity sensor technology.	2	24
David	Set up meeting with Dr. Tuttle to test wafer, went to MRC with group. Continued with simulation of capacitance measurement circuit.	4	27
Sok-Yan	Updated timeline, researched temperature and humidity sensor technology.	4	27

Plan for Coming Week (3/19/18 – 3/23/18)

Additional assembly on prototype and begin software work. Prototyping triangle wave integrator circuit to measure small value capacitors. Develop plan of attack for developing new moisture sensors since existing sensors are unusable.