

901805 - Coastal Biogeochemical Sensing Program

Week 29

1. Irene Hu
 - a. Alkalinity
 - i. After many discussions with Claude about Pt delamination, the observed delamination seems to have to do with too-high voltage at the anode (as well as other “bad behavior” like reversing current, possibly coupled with some fab choices like encapsulation window being larger than anode). Some of the observed voltage is from electrolysis of water, but tens of kilohms of observed resistance (which causes the high voltages) remains unaccounted for.
 - ii. After running various tests on a new chip (eg R/X with AC excitation using LCR meter) to determine source of resistance, no issues can be found- the new chip is showing better behavior than any other previously observed. Hypothesis is that previous chips might have been damaged early on by overvoltage, coupled with some fab inconsistencies.
 - iii. Currently exploring circuit solutions to limiting anode overvoltage. Previous circuit fix on the Howland pump op amp seems to be working.
 - b. Nanofet
 - i. Completed current measurements on a tester circuit for disabling bias battery power. The extra current consumption is $<1 \text{ uA}$ and there is no impact on voltage.
2. Brent Jones
 - a. Finished the alkalinity flowcell. Sent to manuf

Week 28

1. Irene Hu
 - a. Alkalinity
 - i. After experimenting with built-up TApHl 002, was able to get some repeatable titrations with two inflection points. Need to use higher current ($\sim 50 \text{ uA}$) and flushing with a pump in the big tub seems to work better than stirring in a beaker.
 - ii. Alk setup suddenly stopped working; current was railed and stuck on. Behavior matches open circuit anode, and visual inspection shows that the Pt anode deposited on isfet seems to be coming off (similar to observed before). Circuit latching is a separate issue

not previously observed before, and after some troubleshooting and help from Claude, the best hypothesis is that railing the op amp inputs from the open circuit load has damaged the op amp. New part selected and ordered.

- b. Nanofet
 - i. Continuing power draw tests for bias battery disabling circuit

Week 27

- 1. Irene Hu
 - a. Nanofet
 - i. Finished assembling tester circuit for turning off bias battery. Initial tests with Yokogawa showed some unexpected extra transient current draw, traced to sagging voltage on latch's data input pin as GPIO power is cut or left floating. Added pulldowns and has some implications for code.
 - ii. Tester circuit is currently undergoing long term power consumption tests but so far seems promising
 - b. Alkalinity
 - i. Alkalinity chip from Lionix with measured lower anode resistance built into TApHI 002 sensor by Luke. Made connectors and set up for alkalinity titration. Spent a day troubleshooting non-working pH and anode, it started working at some point during tests and best hypothesis is a bubble
 - ii. Initial titrations of TApHI 002 show some working behavior but titrations don't seem to fully hit two inflection points or are inconsistent. Currently experimenting.
 - iii. Updated code to be able to toggle between Vrse and Vrsi
- 2. Brent Jones
 - a. Update counter electrode design to add chamfer
 - b. Change alkalinity flowcell to accommodate Lionix

Week 26

- 1. Irene Hu
 - a. Measured signals and found a code bug for Thom's contractor, NAND flash now communicates
 - b. Finished Nanofet bias battery power toggling board in KiCAD and sent off for fab and assembly
 - c. Some discussions and sent some emails about deploying eddy covariance next year

Week 25

- 1. Irene Hu

- a. Made a small board to test turning off Nanofet's bias battery on command. Board is laid out, waiting for parts to finalize layout
- b. Looked into alternative isfet manufacturers
- c. Measured some signals and looked into code to help Thom's contractor with Nanofet rC new NAND flash issues

Week 24

- 1. Brent Jones
 - a. Diagnosing RS232 comms issue with new nanoFETv2
 - b. Stuffed and bringing up another nanoFETv2 elex package
- 2. Thom Maughan
 - a. Released MoSoS v5.2 for NanoFET, working with Jess on test
 - b. Working with Jim Davis for NAND low footprint filesystem

Week 23

- 1. Irene Hu
 - a. Alkalinity
 - i. Tried polishing electrode and rerunning titration. No noticeable improvement.
 - ii. Finally received a response from LionIX and they have recreated the problem with alkalinity chips
- 2. Brent Jones
 - a. Diagnosing COMMS error in new Nfet2 board stackup

Week 22

- 1. Thom Maughan
 - a. Working on MoSoS v5.2 release for nanoFET, integration on Spray Glider. Expecting to release without NAND support (not needed for Spray2) but will follow in the next month or so with logging to NAND flash. Spot checking, not full testing / support for the release on MFET and MPHOX

Week 20

- 1. Irene Hu
 - a. Alkalinity
 - i. Brent is now designing the flow cell for floating anode (taking over from Joe). Handed over materials.

Week 19

- 1. Irene Hu
 - a. Mini ISUS

- i. Troubleshooting for serial comms errors. Missing bits seems solved by choice of RS232-USB convertor, although also seems sensitive to various factors (eg going through bulkhead/cable) and Saleae trace looks fine
 - ii. Cross talk on Rx/Tx happens on longer cable, Rx is already pulled to GND by receiver. As per Thom, can be improved by twisting each signal with GND.
 - b. Troubleshooting some lioncaps from Indtec. ADC is upside down.
- 2. Thom Maughan
 - a. MoSoS v5.2 on nanoFET. Working thru and testing the command set.

Week 18

- 1. Irene Hu
 - a. Mini ISUS
 - i. Looking into some serial comms errors that seem specific to mini ISUS (intermittent junk characters upon wakeup). Seems to be a timing thing, playing with crystal capacitance. Some cables also seem to cause issues, may need a pulldown.
- 2. Brent Jones
 - a. Diagnosing non verbal CF2 controller
- 3. Thom Maughan
 - a. Started command eval of MoSoS v5.2 on nanoFET, interrupted by LRAUV battery needs

Week 17

- 1. Irene Hu
 - a. Alkalinity
 - i. Ordered some electrode polish
- 2. Brent Jones
 - a. Received first mechanical pressure case parts. Initial build

Week 16

- 1. Irene Hu
 - a. Alkalinity
 - i. Measured a couple more chips and sent package to Lionix with explanatory email
- 2. Thom Maughan
 - a. MoSoS v5.2 is being requested for test and validation and then use on the Spray2.

Week 15

- 1. Irene Hu

- a. Alkalinity
 - i. Continued long tests on self-titrating behavior. Latest hypothesis is a large cloud of acid that lingers in the area
 - ii. Picking out and probing some more chips to send back to Lionix
- 2. Thom Maughan
 - a. MoSoS v5.2, not much this week.
 - b. Installed CCS on a loaner laptop in an effort to help Brent Jones.

Week 14

- 1. Irene Hu
 - a. Alkalinity:
 - i. Ran several more experiments to look into apparent “self titration” of system where it continues to titrate after current stops. Seems to continue for around 15 minutes
 - ii. Trying to investigate the weird precipitate on anode, no results
 - iii. Next flowcell with better spacing control outsourced to Joe, wrote design requirements document
 - iv. Yui has emailed Lionix about the chips; ongoing conversation

Week 13

- 1. Irene Hu
 - a. Alkalinity
 - i. Various tests with floating anode. Generated rough graph of titration time vs distance or current, data is messy. System seems to be titrating itself after titration ends. Experiments with better flushing or reversing current (firmware change). Latest results point to flushing as the main issue
 - ii. Weird precipitate shows up on anode, investigating
 - iii. Probed TA-alk Lionix chips using fuzz button jig. Inconsistent and confusing results. Compiled data into a ppt so Yui can email Lionix.
- 2. Thom Maughan
 - a. MoSoS v5.2 serial command testing on nanoFET

Week 12

- 1. Irene Hu
 - a. Mini ISUS:
 - i. Inventory sleuthing
 - ii. Troubleshooting some random comms issues. On Saleae, the mini ISUS behavior looks fine.
 - iii. Luke observed some freakout in mini ISUS 002 spectra that went away. Plotted data and brainstorming ideas.

- b. Alkalinity:
 - i. Designed and printed, then worked with Roman to fab, small jigs to hold ISFET chips and probe via fuzz buttons (won't scratch like probe tips). Anode still seems disconnected from its pad. Measured diode drop between S/D and substrate, and leakage resistance in other direction
 - ii. Looking at fab files from Lionix via CleWin6, the anode pad seems to be missing a contact hole
 - iii. Modifications to floating anode setup, forgoing the lid (and pumping) in favor of better alignment between anode and isfet. Printed new electrode holder.
- 2. Thom Maughan
 - a. MoSoS v5.2 command testing on nanoFET.

Week 11

- 1. Irene Hu
 - a. Alkalinity:
 - i. Floating anode titrations, not as good as expected but did finally get double inflection point curves (required too-high current and distance didn't seem to make much difference, some weird behavior)
 - ii. Behavior from TApHl anode seems to resemble NC. Probed anode on two alkalinity isfet chips and can't get connection to pad. Resistance to itself varies, the one used in solution seems to have grown a layer. Will talk to Lionix.
- 2. Thom Maughan
 - a. Setting up for testing MoSoS v5.2 on nanoFET after merging Jim's latest update.
 - b. Providing support for mini-ISUS. Luke is experiencing a spurious byte on wakeup with his setup. Jess has a test setup that does not reproduce the problem with the protocol analyzer. Likely culprit is floating TX signal when sleeping for more than a few minutes.

Week 10

- 1. Irene Hu
 - a. Alkalinity
 - i. Starting again on floating anode measurements

Week 9

- 1. Brent Jones
 - a. Mechanical design of nanofet2

Week 8

1. Irene Hu
 - a. Alkalinity:
 - i. Continue tests on TApHI unit. Results confusing, still unclear what is going on
 - ii. Floating anode flowcell was completed by Yamir, started setting up experiment. Micrometer mount needs some modifications, new version printed.
 - b. ISUS:
 - i. OSM poster - finished and printed

Week 7

1. Irene Hu
 - a. Alkalinity:
 - i. Set up lab tests with new TApHI unit. Weird results. Updated connectors, still weird results. There seems to be some high resistance related to the anode that goes away after current is applied for some time but comes back after awhile, accompanied by strange pH results
 - b. ISUS:
 - i. OSM poster
2. Brent Jones
 - a. Bringing up NanoFET2 Durafet board. Wiring, etc
 - b. Replace bad OSC on NanoFET2 digital board and now we are cooking with gas
3. Thom Maughan
 - a. Merged MoSoSv5.2 into the mainline. There are a few issues, notably with serial that will be resolved soon. New development will be on main from now on.
 - b.
 - c.

Week 6

1. Irene Hu
 - a. Tests to understand substrate leakage in DSL continue
 - b. Alkalinity:
 - i. Assemble a low-pressure alkalinity unit with Luke, currently setting up for lab tests
 - c. ISUS:
 - i. Discuss new lamp with Gene, mock fit in Solidworks. Arrange a call with Excelitas for more info
 - ii. OSM poster, had to learn all about calibration protocol

2. Brent Jones
 - a. Bringing up nanoFET2 pcb's
3. Thom Maughan
 - a. MoSoS v5.2 for nanoFET, working with Jim on git merge to main branch
 - b. CCS support for Brent Jones who is bringing up his new formfactor nanoFET.

Week 5

1. Irene Hu
 - a. Alkalinity:
 - i. Finished design for flowcell and other parts for floating anode setup, printed some mockups. Made drawings and sent to MEtechs to make out of acrylic
 - ii. Made some solutions, wire harnesses, and other setup to test the alkalinity DSL in lab
 - b. Various tests to try to understand substrate leakage in DSL
2. Thom Maughan
 - a. PO for Jim Davis
 - b. Started MoSoS v5.2 command testing on nanoFET, MFET, MpHOX.

Week 4

1. Irene Hu
 - a. Alkalinity: Massive redesign of floating anode flowcell, lid, and mounts. To be made out of clear acrylic. 3D printed a mockup, needs some more modifications
2. Brent Jones
 - a. Stuffing NanoFETv2 batt and digital board
 - b. Cable drawings for NanoFETv2

Week 3

1. Irene Hu
 - a. After various iterations of flowcell and electrode holder for alkalinity floating anode experiment, finally tested it... massive leakage, needs further redesign
 - b. Some project coordination for mini ISUS

Week 2

1. Irene Hu
 - a. Revised version of floating anode electrode holder to move it more towards center of flowcell. Started on a little lid.