Monthly Status Report - March 2013
ASTRO Team - MIT - Payload 06
27 March 2013

Prototyping Team

Cheryl Gaul (Aeronautical and Astronautical Engineering, 2016)
Jessica Sandoval (Biological Engineering, 2015) - Team leader
Laura Standley (Mechanical Engineering, 2016)
Linda Xu (Physics, 2016)

Updates: Have manufactured all structural platforms and supports for to-scale prototype. Just have to finish fastening together the prototype. Now have to-scale tangible model off of which we can work.

Issues Encountered: Had difficulties in conversion from SolidWorks Part Drawing file to AutoCAD file. We have also encountered a difficulty in regards to lab access, since members of the prototyping team have access to different labs, making it more difficult to coordinate where to meet.

Milestones: Our initial prototype for the microfluidic electrostatic precipitator is near completion. This will better enhance our spatial understanding of our prototype and will allow us to mount any electronic and microfluidic subsystems in order to perform testing.

Electrical Design

Ethan DiNinno (Aeronautical and Astronautical Engineering, 2016)

Updates: Continuing the build and modifications of the electronics drive system. Anticipate completion by Monday, April 1.

Issues Encountered: We need to replace our NanoLiter Dispenser with a microfluidic pump that outputs a greater volume of fluid.

Milestones: With the help of programming, able to successfully test MIVs and drive fluid through a mock microfluidic setup. Upon testing NanoLiter Dispenser, realized needed a different dispenser to deliver fluid in order to output larger droplet sizes. We are waiting on a sample of a microfluidic pump from the Lee Company.

Programming/Website Development

Rodrigo Gomes (Computer Science, 2015)
Jeremy Kaplan (Computer Science, 2015)

Updates: Wrote a function to control a single pin connected to a Micro Inert Valve (MIV). Currently brainstorming possible website designs.

Issues Encountered: Testing on a board that is equivalent to the final board in software, but not in electronic configuration. Thus, pin numbers are not static. Solution is to generalize pins for now.

Milestones: Code for single-pin control compiles and runs. Website design initiated.

Christopher Carr - Research advisor for ASTRO team

Research/General Notes:

1.) Our collection fluid:

After running calculations in Python, MatLab, and consulting chemical guides, we have determined that a miscible mixture of 1 Propylene Glycol: 1 Water would be our optimal mixture and ratio (in comparison with a solvent of ethanol instead of water). Please consult the table below.

Measurement[1]	100% PG	50%PG, 50%Water Mix
Viscosity (Centipose)	~10,000 (-32 deg C)	250 (-30 deg C)
Density (g/ml)	1.070	1.064
Auto Ignition Temp (in presence of air)	371 deg C	
Flash Point	104 deg C	

Note that the flash and fire points of propylene glycol are above the boiling points of water. PG is essentially non-flammable, and poses little to no health or reactivity risks[2].
PG is readily biodegradable (91.1% biodegradation in 10 day window of 100% PG)[1] .
The vapor pressure of PG is very low, 0.01 mmHg at 0 C and decreases at lower temperatures.
PG has a low freezing point, -57℃, and a 50%PG, 50% Water mixture has a desirable freezing point depression. The primary concern of ours was therefore viscosity, which could be remedied by a 1PG: 1Water ratio. The viscosity of 1PG:1Water at -30 degC is 250 Centipose, two orders of magnitude less than the viscosity of 100% PG.

2.) We are beginning to simultaneously design/develop a prototype that is not reliant on a microfluidics system in order to collect the sample. Instead, this **backup** alternative would allow us the ability to collect using multiple electrodes in separate sample chambers. Essentially, there is a rotating cylindrical body, which is divided into 8 chambers. Every other chamber would have a collection electrode. During the sampling process, an electrode would be exposed to the external environment while voltage is applied for a duration of time. Then, once the sample is collected upon the electrode, a rotation of the cylindrical body occurs, changing to an open, electrode free-chamber. This rotation seals off the used, sample electrode (to which, the voltage is disconnected). Once the HASP flight is complete, we would be able to harvest our samples from the electrode by washing it within a vacuum hood. Further downstream applications (lysing

[1] "A Guide to Glycols." *The DOW Chemical Company*. 2003.
[2] NFPA - National Fire Protection Association

cells, etc) would then be used. This **backup plan** allows us an alternative if we are unsuccessful at implementing a microfluidic collection mechanism.

3.) Jessica Sandoval (Team Leader) and Christopher Carr will be performing field research at a volcano in Argentina from April 8 - 18 (landing on April 19). This poses an issue with team meetings. Individual subsystem meetings will occur during their absence and reports from these meetings will be posted in Team Google Drive file. We will maintain contact through email and our Google Drive Documents.