EE/CprE/SE 491 bi-WEEKLY REPORT 5 - sdmay18-24

3/18/18 - 3/23/18

Project title: Optical force transducer for visualizing cell mechanotransduction in 3D

Client: LIOS Lab Advisor: Prof Meng Lu

Team Members/Role:

Quan Wang ---- fabrication and process development Yalun Tang ---- fabrication and process development Jiameng Li ---- theory and numerical modeling Qinming Zhang ---- theory and numerical modeling

o Past week accomplishments

- Yalun Tang:
- 1. Installed a connector into a new fiber
- 2. Etched the fiber to under 10 um diameter:



3. Coupled the laser into the fiber:



- Quan Wang:
- 1. In past two weeks, I completed four trails of HF etching by using two different holder
 - a. To conclude the result, the etching rate varies among the depth of the holder, cladding layer and core
 - b. The best etching time for holder 1 shown above is 37 minutes etching of 49% HF acid, and 5 minutes etching of 9.8% HF acid
 - c. The best etching time for holder 2 is 34 minutes etching of 49% HF acid, and 3 minutes etching of 9.8% HF acid
- 2. A new set of surface chemistry was completed, as well as the gold nanoparticles attachment. The result shows that the diluted solution of gold nanoparticle will not turn fiber into fragile structure.
- Jiameng Li:
- 1. In the past week, I worked on calculating field intensity of single mode optical fiber by using Gaussian function.



2. V in the picture above means V number, a dimensionless parameter which is often used in the context of <u>step-index fiber</u>. we need to accumulate n1 from fiber core, n2 from cladding, since cladding is disappeared, so n2 is index of water, $\lambda 0$ is the vacuum wavelength.



• Qinming Zhang:

1. New hold has been designed, it is shorter than before. Though the previous one is normal size glass slide, we have to add extra space for glue. It cannot be fitted well when glue is added.



- Group:
- 1. Calculated field intensity of fiber
- 2. Coupled the fiber, and connector is installed
- 3. New surface chemistry, gold nanoparticle attachment, and found suitable HF etching rate for holders.
- 4. New holder was designed

o Pending issues

1. Under SEM, the surface of the etched fiber is very rough:



Therefore, we purchased the Acetic Acid to use it as a buffer to make the etching process better.

o Individual contributions

| Team member | Contribution | Weekly hours | Total hours |
|---------------|---|-----------------|-------------|
| Yalun Tang | Fiber connector installation, fiber etching | 15 | 65 |
| Quan Wang | Surface chemistry, HF etching | 15 | 65 |
| Jiameng Li | Calculating field intensity | 5 | 55 |
| Qinming Zhang | New holder designed | 15 | 65 |

o Plan for coming week

- Yalun Tang and Quan Wang(fabrication):
- 1. To use Acetic Acid as the buffer to perform the etching
- 2. Perform Surface Chemistry and gold nanoparticle attachment
- 3. Immunoassay experiment preparation

- Jiameng Li and Qinming Zhang(simulation and modeling):
- 1. We will work on simulation adding Gold nanoparticles around optical fiber.
- 2. Try to calculate field intensity, and compare with the intensity without gold nanoparticles.
- 3. We will make the real holder from ETG, and if it works good, we will make more same holders in order to improve our work efficient.

O Summary of weekly advisor meeting

During the advisor meeting, we discussed how we can make the fiber surface more smooth; our etching time is very short so the etching rate is higher than usual, either we should increase the etching time by diluting the HF solution, or we can add acetic acid as a buffer to solve the problem. According to the SEM result, we are successful on the gold nanoparticle attachment, but the fiber diameter still did not reach under 10 micrometer. We will send our sample to SEM to see whether we have reached our goal diameter, then we will be able to start our immunoassay experiment.