

## **NDnano Undergraduate Research Fellowship (NURF) 2013 Project Summary**

1) Student Name: Maitiú Ó Ciaráin (Matthew Kerins)

2) Faculty Mentor name: Prof. David Go

3) Project Title: Plasma Jets for Nanomaterial Synthesis

4) Briefly describe any new skills you acquired during your summer research:

- **SEM (Scanning Electron Microscope)**  
I was trained on the SEM machine LEO here in Notre Dame. This gave me an insight into the level of sophistication that exists in research and certainly broaden my understanding of what I thought was possible.
- **Apparatus Construction Techniques**  
The initial challenge was to design an experiment to give clear measureable data. In the process of designing this I learned good and bad practices and how to build experimental apparatus in a structured and safe manor.
- **Clean Room Training**  
I received clean room training for the first time this summer.
- **Further developed my Matlab skills**  
In the course of data analysis I used my previous Matlab skills to pick apart and sort the various data that was collect to present it in a smart and intuitive style.

5) Please briefly share a practical application/end use of your research:

The ability to synthesize nanoparticles in a controlled manner at atmospheric conditions will be vitally important when the devices my peers have been working on go into production. The techniques I've been working on allow for the deposition of 5-10nm spots of silver which could be used to build nano-scale circuitry or wires. What shouldn't be overlooked is that this approach works in atmospheric conditions i.e. no expensive vacuum chambers or clean room standards are needed.

In truth the techniques that I learned and helped develop in the time I spent here will only become of use in the next 20-30 years. However this is project based on looking into the future, identifying a problem and starting to solve it now so as to enable the development and spread of nano technology.

Project summary:

My work began with reading several papers Professor Go sent me prior to arriving in Notre Dame. One of these (Direct Writing of Metal Nanoparticles by Localized Plasma Electrochemical Reduction of Metal Cations in Polymer Films – by R. Mohan Sankaran et al) was the starting point for my research. Dr. Sankaran had use an Aragon plasma jet to synthesize silver particles in both a solution and thin film of Silver Nitrate and PVA. Initially I reproduced his work with plasma then moved on to reproduce similar results with field emission. Field emission is a quantum mechanical process by which electrons tunnel from a surface due to a high electric field. These electrons induce the same electro-chemical reaction as a plasma i.e. the breakdown of silver nitrate to solid metallic silver particles.

The SEM machines became a crucial part of our work since they allowed us to actually see the nanoparticles. As we refined the procedure SEM images of the surface were taken before and after. With these images and the IV data we were able to prove that the nano-particles we were seeing were as a direct result of field emission. Overall I enjoyed the entire project. I was able to put the theory I've been learning for the last 3 years into practice and gained a real insight into what is really involved in academic research.