‘I dived head-first into electrochemistry and I haven’t looked back since!’

Louise McGrath, PhD Researcher, UCC & Tyndall

After receiving her bachelor’s degree in chemistry with forensic science from University College Cork (UCC), Louise McGrath was awarded a research internship under the supervision of Dr James Rohan in the Electrochemical Materials and Energy group at the Tyndall National Institute.

Now, as a PhD researcher, she is currently working on nanomaterial-based devices for advanced energy storage and delivery for applications in smart sensors. Last May, she participated in Researchfest as part of Inspirefest 2019.

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> – LOUISE MCGRATH

What inspired you to become a researcher?

I was inspired to become a researcher once I started my fourth-year research project. This project ignited a passion that I didn’t realise I had.

I knew I wanted to work in something related to chemistry, but it’s clear now that I really wanted to be a researcher. This is because I am constantly learning and being challenged.

No two days are the same for me, which I absolutely love. I have become more knowledgeable over the years, and I look forward to learning new things as I work on more projects. I dived head-first into the world of electrochemistry and I haven’t looked back since!

Can you tell us about the research you’re currently working on?

Currently, I am almost at the end of my PhD research project, which was funded by Connect, the SFI research centre for future networks and communications.

Its focus includes the internet of things (IoT), a concept where all the things we use become smart and can communicate with each other through the use of sensors.

In order to put sensors into objects and buildings, we must make them very small. My research involves creating miniaturised batteries – batteries which are smaller than the nail on your baby finger, with the goal of ultimately making them as small as a grain of sand.

In order to make a battery, I needed to focus on three main components: the cathode, the anode and the electrolyte. Each of these components come with their own challenges, so I had to carefully research each component and test them to make sure they would be suitable for miniaturised batteries.

Over the past few years, I have been trying to create the perfect combination of materials which will create a high-powered microbattery. Not all materials will work together in perfect harmony so, just

like cooking, I need the perfect ingredients!

I have chosen materials which are more environmentally friendly and safe, but which deliver high power, even in a very small area or volume. In addition, this combination will produce a long-lasting battery, which will hopefully power sensors very soon.

In your opinion, why is your research important?

My research is important because sensors need power, which can be provided in two ways: energy harvesting and energy storage. Energy harvesting involves gathering energy through solar power, vibrations, temperature gradients, wind and so on. Harvesting is a great way to obtain power.

However, the power cannot be stored, which is where my research steps in. Batteries can store excess energy produced and release the energy when required.

Also, the batteries can power sensors on days when the energy harvester may not work. For example, if a sensor is placed in an office building and the energy harvester produces energy when people walk around by collecting the vibrations, what happens at the weekend when no one is working?

The battery will be charged by the energy harvester during the week, and at the weekend the battery will power the sensor. This makes sure that data from the sensor can be communicated at all times.

What commercial applications do you foresee for your research?

Working in Connect has been very helpful in identifying the commercial applications of IoT research. If I created a very high-powered battery that could be scaled up in size, then commercialising it would be very attractive.

Batteries are in high demand and as the materials I am using are safer and more environmentally friendly, I could potentially access the electric vehicle market as well as the portable device market.

What are some of the biggest challenges you face as a researcher in your field?

One of the biggest challenges is selecting the correct combination of materials, as the materials may work very well when tested separately. But when you make the battery and test all the components together, it might not work very well at all. It can be very frustrating.

In addition, there are so many materials to choose from, so when you are trying to fix a problem, you have many solutions to choose from, which may or may not work.

Are there any common misconceptions about this area of research?

Batteries tend to get a lot of bad attention as media has reported phone batteries catching on fire. Whenever someone mentions batteries, they often think of explosions. I have even been asked if I have ever made my battery explode.

One way I address this is by engaging in science communication. In SFI research centres such as Connect, we get a lot of support and encouragement to engage with the public about our research.

Recently I took part in Researchfest and explained my work and why it is important. I also carry out demonstrations at various outreach events showing people that they can make batteries in their own home, showing them that batteries can be safe.

I can answer questions and put people's minds at ease at these public engagement events. It is really rewarding to engage with people as I've been asked really interesting questions which have made me stop and think. It's fantastic to see so much curiosity and interest.

What are some of the areas of research you'd like to see tackled in the years ahead?

I think finding and using clean energy sources is really important to protect the environment. Energy harvesting (solar panels, wind farms, wave technology etc) and energy storage (batteries and fuel cells) are particularly important.

Ultimately, I think we should focus on fuel cells because they rely on hydrogen gas, which can be obtained from a variety of sources such as water and methane. If we can store energy in a clean and efficient way, then hopefully we can protect our environment from further damage.