A solid oxide fuel cell’s (SOFC) journey to a light flight.

Layering and coating of a multi-impregnated ceramic fibre paper to ultimately form a SOFC unit. Also, there will be spaghetti carbonara and cake.

Fuel cells can in a long perspective contribute to decrease the dependence on fossil fuels mainly due to two reasons. Firstly, it has a higher efficiency relative to combustion engines. Secondly, hydrogen, the most common fuel, can be produced from water, using sustainable energy sources such as wind and solar power. However the most common source of hydrogen is currently from fossil fuels.

What if a SOFC could be made with a lighter weight? This would have a great effect on mobile applications such as drones for a number of reasons. A lower weight would result in less fuel consumption. This in turn would make it more cost effective and increase the drone’s air time. The technique attempted in this thesis could, when successful, contribute to cheaper manufacturing of portable energy devices. For instance you could recharge your laptop or your cell phone using this technology.

Imagine a network of spaghetti looking fibres, randomly distributed yet connected to each other. This is how my starting material looked like at10X magnification. How was I supposed to turn this carbonara in to a high-tech energy device? In this work I assessed a method for the construction of a light-weight SOFC. The low weight is achieved by using a ceramic fibre paper. Through a series of vacuum impregnations followed by multiple layer applications, the paper was transformed to a SOFC. Each step ended with heat treatment. It was like making a ridiculously complex cake. The SOFC consists of three main parts: anode, electrolyte and cathode. In order for the anode to work properly it needs to conduct electrons and be catalytically active. This was achieved by incorporating metallic nickel into the structure. However, energy dispersive spectroscopy analysis showed that the anode might have an uneven distribution of nickel.

To verify the functionality of the fuel cell the electrolyte, which can be seen as the heart of the fuel cell, was investigated. This was done by a scanning electron microscope. It was seen that the electrolyte surface contained small cracks which might cause gas diffusion between the anode and cathode. For the SOFC to work properly there should not be any mixing of the gases. A performance test was conducted in order to see if it worked. However, due to malfunctions in the system, no conclusions could be drawn from the test.

For future improvement, an automated process should be developed, since the method is currently too time consuming to be economically viable.