Thin Film Coatings
Associate Professor Peter Murphy  
Associate Director, Mawson Institute  
p: +61 8 830 23564  
e: Peter.J.Murphy@unisa.edu.au

Dr Drew Evans  
Research Fellow, Mawson Institute  
p: +61 8 830 25719  
e: Drew.Evans@unisa.edu.au

Mr Colin Hall  
Research Fellow, Mawson Institute  
p: +61 8 830 23833  
e: Colin.Hall@unisa.edu.au
Mawson Institute
Advanced Manufacturing - anticipating the future

Our Vision
To be the research provider of choice for new technological platforms that produce transformational change in manufacturing practice, or improve wellbeing and quality of life.

Our Mission
Our focus is on the science and engineering that underpins “next generation” manufacturing, providing technology platforms based upon new knowledge and innovation that can be readily integrated into new products and processes. Scientists and Engineers work in parallel on concepts and commercialisation, significantly reducing the time and steps in product development.
Innovation with Application

Thin film coatings are at the core of many high-tech products and devices, from solar cells and flat panel TV screens, to smart phones and spectacle lenses. When applied to plastic substrates, there is the opportunity to create high value add products that are not only light weight, but also superior in performance to more traditional materials such as glass. By replacing glass with plastic, there is an immediate weight saving of 50%. Without thin film coatings, the plastic substrates would not survive exposure to environmental conditions (eg: UV light, rain, temperature variations) and everyday wear and tear (abrasion damage, chipping, scuffing etc).
Associate Professor Peter Murphy's research group focuses on the application of thin film coatings to plastic substrates. This is a multidisciplinary science, involving aspects of materials science, physics and chemistry. Thin film coatings typically vary from a few nanometres (nm) to a few microns thick. For example, the anti-reflection coatings on spectacle lenses and solar panels typically consist of at least 5 thin film coating layers, with a combined thickness of around 300 nm (0.3 microns). By way of comparison, a human hair has a typical diameter of 50 – 75 microns (1 mm = 1000 microns). Thin film coatings are therefore a great example of nano-engineering!

The research group's areas of specialty include:

- Fundamental research
- Applied research
- Product evaluation, testing and benchmarking
- Process development and scale up from laboratory scale to pilot production
- Technology transfer from the R&D environment to the manufacturing environment

We have experience in designing and applying the following types of thin film coatings:

- Abrasion resistant coatings
- Water repellent coatings
- Anti-reflection coatings
- Electrochromic coatings
- Barrier coatings (moisture and gas)
- Low friction coatings
- Corrosion resistant coatings
- Anti-static coatings

Coating techniques available in our laboratories include:

- Magnetron sputter coating
- Plasma Enhanced Chemical Vapour Deposition (PECVD)
- Electron beam evaporation
- Spin coating
- Spray coating
- Dip coating
- Vapour Phase Polymerisation coating

Evaluation & Test Facilities available within our laboratories include:

- Atlas weatherometer (UV testing)
- UV/Vis/IR spectrophotometer
- Coating thickness measurement
- Coating stress measurement
- Abrasion resistance testing
- Coating adhesion measurement
- Chemical resistance testing
- Thermal shock testing
- Nano-mechanical testing
Plastic Automotive Mirrors

UniSA, through the Mawson Institute and Ian Wark Research Institute, the CRC for Advanced Automotive Technology and SMR Automotive, have jointly developed a world first plastic automotive mirror that is now being commercially produced for OEM customers in the USA. Developed over a 3 year period and tested to rigorous industry standards, the world first plastic mirror incorporates a multilayer thin film coating that has several features including abrasion resistance, a reflective mirror’s surface, corrosion resistance and a super hard capping layer.

Plastic Electromaterials

Plastic materials are used in almost every aspect of our daily lives. From children’s toys to kitchen appliances to cars, plastic materials are most commonly used because they are durable, easily coloured, light weight and they can insulate a user from electricity. What if the plastic could be made to change its colour and/or to conduct electricity? Plastic electromaterials (known in the scientific community as Conducting Polymers) are novel in that they conduct electricity rather than insulate, and they can be made to switch their colour.

The discovery of conducting polymers (Nobel Prize in chemistry in 2000) has led to a range of organic electronic devices being invented. These include organic lighting, organic solar cells and electrochromic devices to name but a few. Associate Professor Murphy’s group is developing these plastic electromaterials for use in such devices for real world applications. A direct outcome of this research has led to the development of the world’s most conductive plastic electromaterial, which is touted as a direct replacement of existing materials in smart phones, flat panel displays and touch pad technology. To achieve this, the plastic was engineered on the nanoscale to have the ideal structure for the ultrathin plastic film.

Another example of the group’s research outcomes is developing devices that can be optically switched; known as electrochromic devices. Electrochromic devices are already used in aeroplane windows (Boeing 777 Dreamliner), automotive rear-view mirrors and architectural glass. By using plastic electromaterials these devices can be made lighter, energy efficient and flexible.
Nanocomposite Materials

Nano-composite materials consist of nano-particles (one thousand times smaller than the width of a human hair) mixed in and through another material. The result is a new composite material that can possess some rather exotic properties. An excellent example of this is the Lycurgus cup, an ancient Roman artefact from the 4th century, which uses a nano-composite glass. This glass appears green when light is reflected off its outside, while appearing red when illuminated from the inside.

Nano-composite materials are already used in the real world in bulk form in applications such as light weight highly lightweight durable car bodies, fire retarders, and gas barriers. Associate Professor Murphy’s group is conducting research on engineering the nano-composite materials as thin films. When these thin films are combined with plastic substrates, high value-add products can be manufactured that are light weight and energy efficient. The ophthalmic industry already utilise nano-composite thin films to produce scratch resistant plastic lenses for spectacles. Alternatively, the electronics industry are utilising nano-composite thin films on their touch panels, smart phones and tablets to make them easier to clean. This easy clean property mimics what plants in nature already do by repelling water droplets.

An outcome from the group’s research has been the development of the world’s first plastic automotive mirror, where nano-composite thin films are an integral component. Engineering the films on the nanoscale allows for materials to be created that can stand up to the rigorous testing of the automotive industry. This new commercial product is now being exported globally to a number of automotive manufacturers.