

**U3A Science and Technology Group  
Meeting 13 March 2023  
Roy's March Miscellany**

This talk by Roy Tranter was themed on optics and nanotechnology - increasingly important areas, both in manufacturing and in everyday life. It is about structures that can be made in the 1-100 nanometre scale and have unusual effects on optical and electronic properties of materials.

Roy started by looking at some naturally occurring nanostructures. Many of the colours of butterfly wings are not due to pigments but to very fine repeating structures in the wings that reflect and diffract white light in such a way that only one particular colour is transmitted through, or reflected by, the wing. A similar effect is seen with particles of gold in the 10nm size range - the particles appear as rose pink to deep red, depending on size; an effect made use of by glass manufacturers from at least mediaeval times. Gecko feet also incorporate nanostructures and this enables them to "stick" on very smooth surfaces, such as glass, even when upside down - there is no glue involved, only the physical interactions between the structures on the feet and the glass.

Needless to say that manufacturers are copying these structures to create permanent, non-fade colours, and ways of sticking things together that can be peeled apart without damage to either surface.

Etching a pattern of nanostructures on the flat end of an optical fibre gives the fibre a lens without having the bulk of a conventional lens. Other patterns allow the fibre to act as a temperature, pressure or chemical sensors. Such devices are finding their way into medical probes as well as monitors for manufacturing processes.

All current computers, including phones and televisions, use electronic components to work. Changing to systems that manipulate light, instead of electrons, would save an enormous amount of electrical energy. Such devices are in active development and already starting to appear in some niche areas, particularly where weight and power need to be minimised. LIDAR systems for cars and augmented reality glasses are just two examples, but healthcare, bio-chip test systems, CT scanners, food and environmental monitoring are all targets.

At the extreme end of research, quantum dot chemical sensors, single photon detectors for use with very low intensity light, and quantum batteries that could give instant charging are all being worked on.

Nanostructures are clearly the future!