Better Bionic Eyes and Ears

by Fresh Science, with reporting by Kim Ukura, Associate Editor, Product Design & Development

A researcher from the University of New South Wales (UNSW) has created conductive bioplastics which will transform the performance of bionic devices like the cochlear ear and the proposed bionic eye.

“Our plastics will lead to smaller devices that use safer smaller currents and that encourage nerve interaction,” says biomedical engineer Rylie Green.

Green’s plastics are already being tested in prototype bionic eyes and she hopes they will find application in bionic ears and robotic limbs using spinal cord and peripheral nerve cells – wherever researchers are attempting to integrate electronics with the human body. Bionic devices connect into the nervous system. Right now, the electrodes they use are made out of metals like platinum and iridium which don’t always work with the body because metals have smooth surfaces. The body immediately tags the electrodes as foreign material and tries to wall them off by growing fibrous, scar tissue around the implant.

Over time, larger and larger electrical currents must be used to stimulate the nerves through the scar tissue. Eventually, this results in the surrounding tissue and body fluids being subjected to unnatural changes in acidity and toxins produced from the metal contacts which can damage cells.

The conductive plastics or polymers that Green has worked with since 2004 are a coating for the metal in bionic devices. At the time, Green says scientists were primarily using these polymers to record signals from the brain on recording electrodes.

Green thought they could also beneficial with stimulating electrodes, so she commissioned a lab to look at naturally conducting polymers and explore how they could be used to improve implants.

“The polymers are formed directly on the implant electrode by application of an electrical current, while the electrode is immersed in a solution which contains the ‘ingredients’ which come together to make the polymer (a monomer solution),” Green explains.

“To make them more conductive and hence effective at passing current to the body they are made with charged particles called dopants, which are also included in the monomer solution,” she continues. After testing a number of molecules, Green found several that interact with nerve cells and can cause them to attach to the electrode and grow across the surface to form an “intimate connection” with the electrode.

Rylie has also been able to improve performance by incorporating natural body proteins. Upon implantation, these proteins help the cells near the electrode to survive and grow, and can reduce the formation of scar tissue. This is especially important in implant recipients where the existing tissue is damaged, as is the case with most deaf and blind patients. The biggest barrier for applying this technology is that conducting polymers are not yet approved for use in humans, Green says.

“A significant part of our future work will be in generating the required data which demonstrates that these materials are safe and stable when implanted,” she explains.