Times 16th October 2015

Synthetic skin brings sense of touch to artificial limbs

Oliver Moody Science Correspondent

Artificial skin that can feed a rudimentary sense of touch back to the brain could transform the lives of people with prosthetic limbs.

Engineers have developed a plastic sheet fitted with sensors that can measure how much pressure is being applied to it and send the information directly to a mouse neuron.

Their ultimate goal is to replicate human skin's ability to bend, heal itself, and transmit detailed information about temperature, pain and touch.

The prototype, which mimics the cascades of electrical impulses used by the body's network of nerves, is an important step towards allowing people to recover feeling after losing limbs or skin. One day the technology may even eliminate the "phantom limb" pain that afflicts many amputees. The breakthrough brings together many of the most cutting-edge disciplines in 21st-century science, from nanoscale electronics to advanced genetic engineering that can be activated at the flick of a light switch.

The "skin", created at Stanford University in California, has two layers. The upper layer is a waffle-like structure containing billions of carbon nanotubes — microscopic cylinders that can conduct an electrical current. Pressing down on the surface pushes the nanotubes together so that more electricity can flow through the material.

Beneath it is a second layer covered with ultra-thin electrical circuits sprayed on by an inkjet printer. These pass variations in the current to a row of mouse brain cells genetically engineered to switch on when a light shines. The electricity is converted to pulses of light, which successfully fired the neurons when the scientists touched the surface of the skin.

Writing in the journal *Science*, the researchers said that their device could be scaled up to cover large objects — the average person has a surface area of 2 sq m — and hooked up to human nerves in the same way as a new generation of prosthetic limbs that can be controlled with thought.

Getting this far took the researchers a decade. Turning the models into a commercial replacement for skin that imitates the full range of sensations it feels might take even longer, but the new study was proof that it could be done, according to Zhenan Bao, one of the paper's authors. "We have a lot of work to take this from experimental to practical applications," she said. "But after spending many years in this work, I now see a clear path where we can take our artificial skin."