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First ever artificial 'cyborg' tissue developed

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Harvard scientists have created the first ever artificial tissue by embedding a 3-D network of functional, biocompatible, nanoscale wires into engineered human tissues.

The team led by Charles M Lieber, professor of chemistry at Harvard and Daniel Kohane, professor of anaesthesia at the Harvard Medical School, developed a system for creating nano-scale "scaffolds", which could be seeded with cells that later grew into 'cyborg' tissue.

"With this technology, for the first time, we can work at the same scale as the unit of biological system without interrupting it," said Lieber.

"Ultimately, this is about merging tissue with electronics in a way that it becomes difficult to determine where the tissue ends and the electronics begin," Lieber said.

"In the body, the autonomic nervous system keeps track of pH, chemistry, oxygen and other factors, and triggers responses as needed," Kohane explained, according to a Harvard statement.

Using the autonomic nervous system as inspiration, researchers worked in Lieber's lab at Harvard to build mesh-like networks of nanoscale silicon wires, about 30-80 nanometres in diameter, shaped like flat planes or in a reticular conformation.

"We need to be able to mimic the kind of intrinsic feedback loops the body has evolved in order to maintain fine control at the cellular and tissue level," said Kohane.

The process of building the networks, is similar to that used to etch microchips. Once complete, the networks were porous enough to allow the team to seed them with cells and encourage those cells to grow in 3D cultures, Lieber said.

"Previous efforts to create bio-engineered sensing networks have focused on 2-D layouts, where culture cells grow on top of electronic components, or on conformal layouts where probes are placed on tissue surfaces," said Bozhi Tian, a former doctoral student under Lieber.

"It is desirable to have an accurate picture of cellular behaviour within the 3D structure of a tissue, and it is also important to have nano-scale probes to avoid disruption of either cellular or tissue architecture," Tian said.

Using heart and nerve cells, the team successfully engineered tissues containing embedded nano-scale networks without affecting the cells' viability or activity.

With the help of embedded devices, they were able to detect electrical signals generated by cells deep within the tissue, and to measure changes in those signals in response to cardio or neuro-stimulating drugs.