Biomaterial called scientists' best hope for growing nerves

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A new biomaterial made from self-assembling molecules like so many "smart Legos" could be the best substance yet found on which to grow nerves for repairing damaged brains, say scientists at MIT and New York University who discovered it.

The material could be formed into any shape, sown with billions of nerve cells, and implanted into the brain or spinal cord. Then it would degrade, leaving just the new nerves, like a living patch.

The researchers said yesterday they were surprised to find that nerve cells, which are "notoriously fussy," attached themselves to the thin sheet-like material and promptly grew long extensions that made connections, or synapses, just as they do in the body.

The material is not only friendly to nerves, but appears not to cause inflammation or rejection when implanted into the body, the scientists report.

But it could have many other uses, too. "The reason this material is so interesting and unique is that we can individually tailor it to grow virtually every type of cell in the body" for tissue engineering, said Shuguang Zhang, associate director of Center for Biomedical Engineering, at the Massachusetts Institute of Technology.

He and Todd C. Holmes, a former MIT researcher now at NYU, wrote about the material in today's issue of the Proceedings of the National Academy of Science.

In a commentary appearing in the journal Nature, a German scientist noted that repairing damaged nerves is a longtime goal and, that while that day is far off, the new biomaterial "may bring us closer to that goal."

Robert Langer, professor at the Massachusetts Institute of Technology and a pioneer in the growing field of tissue engineering, said yesterday that the report was "interesting" but that its performance in the body needs to be tested further.

Zhang first synthesized the material, known as EAK16, about 10 years ago, and Holmes then discovered its useful properties, the researchers said in interviews.

The material is 99 percent water; the remaining 1 percent is interlocked molecules called peptides that are the building blocks of all proteins. A solution of these peptides in water will assemble themselves if salt is added, said Zhang, calling the peptides "smart Legos" because they contain information that enables them to link themselves in repeating patterns like the plastic building toys.

Peptides, it is now known, can assemble themselves into larger structures, such as fibers, small tubes, sheets, and particles, and can be programmed to disintegrate in the future.

After Zhang made the peptide-based material, "he was shopping around for other uses for it," said Holmes. A few years later, Holmes discovered that the shape of the molecules fit nicely into structures nerve cells need to attach themselves. Experiments then showed that the nerve cells easily attached to the material and, in a sign that they were "happy" in that situation, grew their long spidery projections called axons that link up with other nerves to form circuits. "If nerve cells are not happy, they may grow" but won't make the vital connections, Holmes said.

"I would say this is the best material" yet found to support growing nerve cells, Holmes said.

Since the material is synthesized, it can be tinkered with to have different properties, said Holmes, and because it isn't extracted from animal tissue, as some scaffolding biomaterials are, there's no chance of spreading harmful viruses by implanting it into the body.

Other biomaterials are made of plastic, which has the downside that when it degrades it may be toxic to the recipient, Holmes added.

The research was supported in part by Hercules Inc., a Wilmington, Del., chemical manufacturer of pulp and paper, resins, fibers, and other products.

The cost is one hurdle that will have to be overcome if EAK16 is to widely used, the researchers said. At present, it costs $1 million a liter, or $2.2 million per pound.

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