NanoWorld: Nature Inspired Micro Circuits

A team of chemical engineers, biologists, geneticists, and electronic engineers headed by Kenneth Sandhage at the Georgia Institute of Technology and colleagues has developed a new process for converting the finely detailed silica skeletons of diatoms into synthetic replicas constituted by materials like titanium dioxide, which could be used in electronic devices.

Diatoms are single-celled algae that live in water and assemble a shell, or frustule, of silica by converting nutrients and light. They can adopt an astonising variety of shapes – from simple geometric structures like triangles and squares to extremely complex 3D constructs with thousands of individual pores. There are more than 100,000 different species of diatom that are known to exist in nature – some of them being only tens of nanometres in size. They have an astonishing ability to replicate.

Kenneth says: “I was travelling by bus and my copassenger was a marine biologist. She was excited about the structures created by diatoms. Her enthsiasm was infectious. It prompted me to find ways and means to grow such organsim. It was later on that we thought of developing them for use as nanodevices.”

He adapted the nature’s technique of diatom’s own ability to reproduce as a means to mass-produce intricate three-dimensional structures. “This part was easy, but the real work entailed coating the diatom shells with metallic substances”,” the alternative being to replace the diatoms”. The team used conventional techniques like photolithographic. When contacted, Kenneth stated that he and his collaborators have so far devised a handful of ways to convert the silica encasing diatoms into other materials, some of which could prove electronically useful. “We created the nano-structure of barium titanate by modifying silica with gaseous metal at very high temperature and thereafter coating.”

Kenneth Sandhage is quite hopeful that in near future it might be feasible to fabricate diatom structures to order. This is possible by exploiting a growing understanding of their genetic properties. They could then be chemically converted into nano-components. Kenneth says that his team has developed a couple of uses for the new structures, including using materials that catalyze chemical reactions as the coating for diatoms.

The potentials of diatoms are immense. The catalyst-coated diatoms can used to destroy pesticides. This is a technique that might one day be gainfully employed to protect the eco-system. It can prevent the leaching of obnoxious chemicals. There is also a possibility to use them in computer displays. Nature becomes the mentor for new developments.

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