Yanik wins Packard fellowship for neural microchip work

Mehmet Fatih Yanik has stopped light in its tracks and created a self-contained biology laboratory, complete with a large number of living test subjects, on the surface of a microwire. Now he is focusing on learning how to keep nerve cells alive and regenerating after they have been damaged during degenerative and traumatic processes.

This research just received a big boost. Yanik, 29, was one of 20 young scientists awarded in 2007 David and Lucile Packard fellowship in science and engineering, and he received an unrestricted five-year grant of $825,000.

This award continues a string of recent honors for Yanik. Last month he was a New Innovator Award from the director of the National Institutes of Health, which carries a total of $2.5 million in new funding. In August, he was named one of Technology Review magazine’s TR35, the world’s top innovators under the age of 35.

Yanik is an assistant professor in MIT’s Department of Electrical Engineering and Computer Science and the Research Laboratory of Electronics, and the grants to help his work on developing microchips that can mimic living neurons in action. In some cases, he will observe the neurons as they live inside a living body, for the first time ever. As a result, Yanik is widely used in biological research because of its simplicity and fast lifecycle. In other words, having primary mammalian neurons as well as human neurons produced from laboratory strains of stem cells can manipulate and monitor them at the molecular and cellular resolution. In both cases, the key to the research is the development of a complex high-thoughput micromanipulation systems, which can carry out large numbers of tests simultaneously. This would allow Yanik and his students to fabricate and test on a chip both living cells and neurons in a cellular precision. This would streamline the research process considerably.

Yanik and his students have already produced microchips designed with a number of tiny channels, complete with branching passages, control valves and vacuum-suction segments, which are filled with water to carry large numbers of C elegans at one time, and, in particular, the students.

In a recent work, he also demonstrated how to conduct very precise laser surgery on the tiny animals using femtosecond laser pulses, which made it possible to sever a single axon, the thin filament that delivers the output of a neuron, inside a body. In other words, having primary mammalian neurons as well as human neurons produced from laboratory strains of stem cells can manipulate and monitor them at the molecular and cellular resolution.

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Now, Yanik plans to conduct large numbers of such tests all at once on a single chip. This is being done using different chemical compounds and genes that might speed regeneration of the damaged neurons or inhibit their degeneration. These high-throughput technologies could be used to produce “new drugs and genetic targets” he says.

A similar technology his group is developing could be used to screen the effects of a variety of potential drugs on primary mammalian neurons in vitro as well as human neurons derived from embryonic stem cells. “We can test them with drug candidates in a very cost-effective and efficient way and then affect regeneration or degeneration of the neurons or at least slow down the resolution of the diseases,” he says. To produce neurons that more closely resemble those in a living body, Yanik’s team is working on building three-dimensional structures to provide small scale environments for the neurons in the lab.

Earlier in his career, Yanik invented a physical mechanism to bring light to a standstill in a material, opening the possibility of storing information in a completely new way. He also appreciates the flexibility of the Packard award, which can be applied to other work as his research develops. “There may be a need on high-risk, high-importance work,” he says.

Rafael Bras to receive AGU’s Horton Medal

Bras has been named this year’s winner of the AGU Horton Medal, the highest honor the American Geophysical Union (AGU) gives to hydrologists. It is made possible by an endowment established in honor of Robert E. Horton (1891-1984), a professor of civil engineering at Harvard University and a leader in the field of hydrology for several decades.

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The award, which recognizes individuals and organizations for their outstanding contributions to the advancement of water resources science, engineering and technology, and the protection of the world’s water resources, will be presented to Bras during the AGU Fall Meeting in San Francisco on December 15.

Bras is being recognized for his work in flood forecasting for the Pacific Northwest, his research on fluvial landscapes and their evolution, and for advancing the theory and practice of hydrologic sciences, including rainfall-runoff modeling, earth surface processes, remote sensing and modeling of precipitation and distributed hydrologic modeling.

The AGU Horton Medal was established in 1985 by the American Geophysical Union as a memorial to Robert E. Horton, the first AGU executive director and the highest honor given by AGU to hydrologists.

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