Goodbye large neural probes: Changing electrophysiology methods with an ultrasmall needle technology

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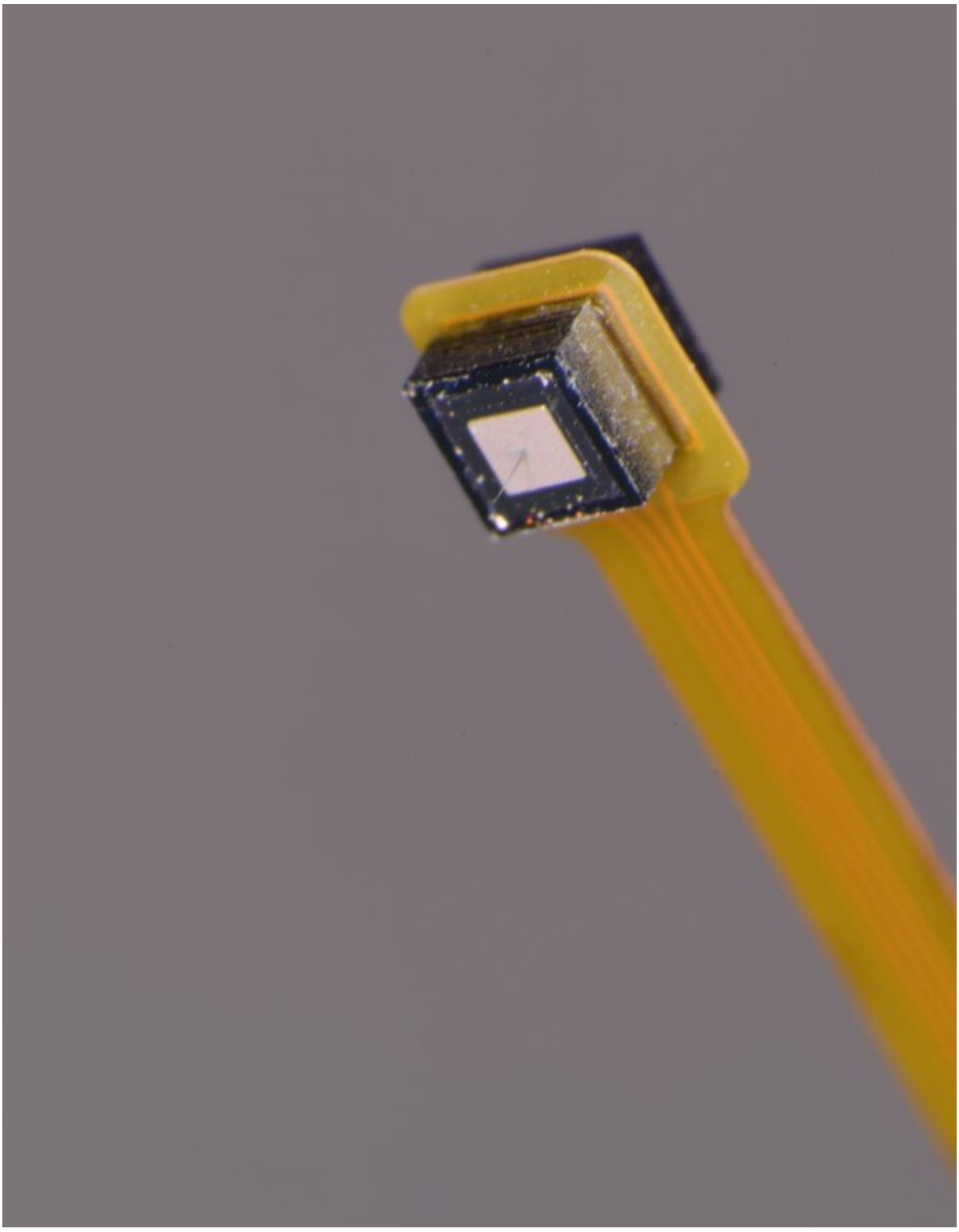

A block module of a 3-μm-diameter and 400-μm-length needle-electrode

(frontside block, 1 × 1 mm2) is stacked on an amplifier module (backside block) via a flexible interposer. Credit: Toyohashi University of Technology.

A research team at the Department of Electrical and Electronic Information Engineering, Department of Computer Science and Engineering, Department of Applied Chemistry and Life Science, and the Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) at Toyohashi University of Technology, and the National Institute of Technology, Ibaraki College has developed a [2].

The STACK device enabled the recording of neuronal activity from a mouse's brain in vivo with a high signal-to-noise ratio (SNR). Because of the significant advantage of the small needle geometry compared to conventional electrodes, the STACK device offers high biocompatibility and minimized tissue damage during recording, as well as further long-term and safe chronic recordings, toward the next generation of electrode technology in electrophysiology.

Microneedle electrode devices have been used as a powerful means of understanding how the brain works. However, the needle's geometry should be further miniaturized in terms of biocompatibility and chronic application to avoid tissue damage: (i) Geometry of approximately 50 μm enhances the blood-brain barrier breach; (ii) > 20 μm causes a distribution of the local communication between glia; and (iii)

The research team has overcome these limitations by using an assembly technique by which a module with a 5 MΩ at 1 kHz), the needle geometry can be further miniaturized, probably to nanoscale, which will open a new class of electrophysiology."

More information: Yuto Kita el al., "Three-micrometer-diameter

needle electrode with an amplifier for extracellular in vivo recordings," *PNAS* (2021). www.pnas.org/cgi/doi/10.1073/pnas.2008233118

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