Nanoscale Processes and Neural Systems

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The biological processing system

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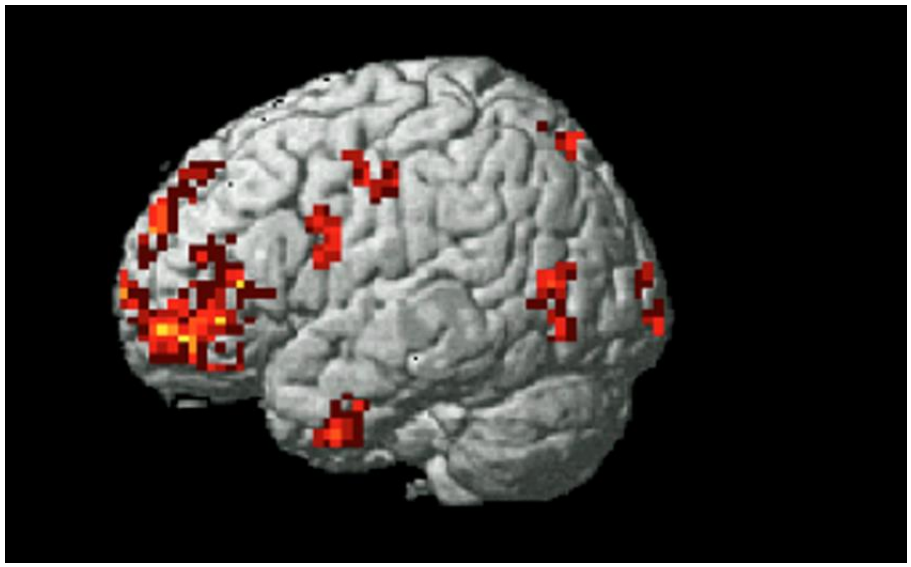
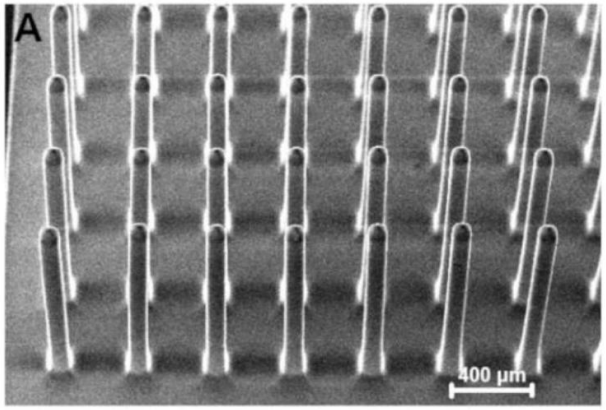


- fMRI imaging
- Neural correlates of emotion: spatially distributed activation

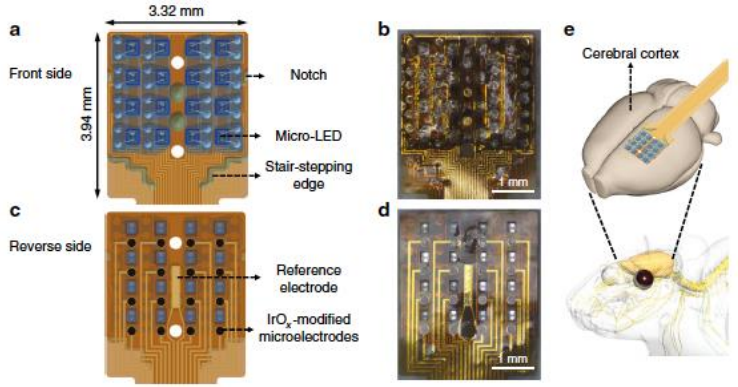
K. S. Kassam, A. R. Markey, V. L. Cherkassy, G. Loewenstein, M. A. Just, PLOS **8**(6) e66032 (2013)

Probes

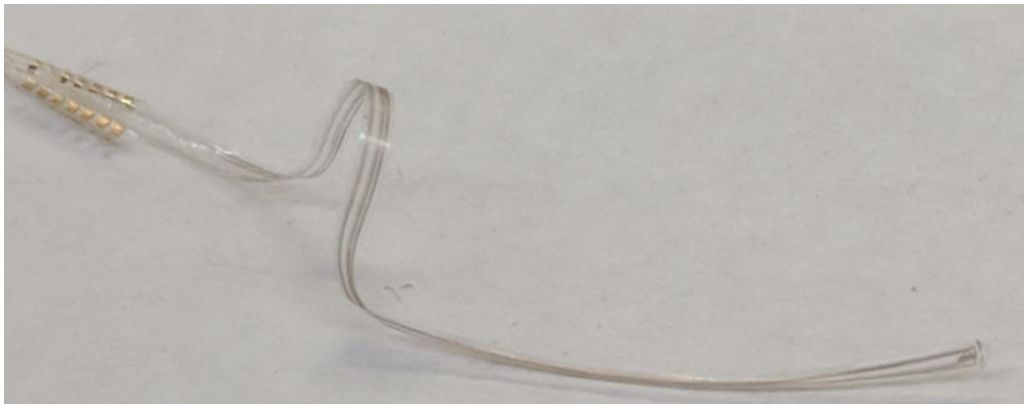
Probe resolution ~ 100's of microns



B. Ji, Z. Guo, M. Wang, B. Yang, X. Wang, W. Li, J. Liu,
Microsyst4ms & Nanoengineering, doi: 10.1038/s41378-018-0027-0



N. McAlinden, Y. Chen, R. Schart, E. Xie, E. Gu, M. Dawson,
C. Reiche, R. Sharma, P. Tathireddy, L. Rieth, S. Blair, K. Mathieson.,
bioRxiv (2018).



J. Reddy, I. Kimukin, M. E. Towe, M. Charmanzar
Frontiers of Neuroscience (2019)

What can we learn at the nanoscale?

- Single neuron: 4 – 100s um (macro characteristics);
- single synapse: 20 - 40 nm (quantum mechanical behavior expected);
- How to relate what is learned at the nanoscale to the macroscale and ultimately to system behavior;
- Can we fix neurological malfunction with electronic and photonic chips?
- Can we build intelligent systems that use the principles of the the biological brain (once we figure them out)?