Multifunctional neural interfaces with micro- and nano-structured tapered optical fibers

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There is widespread agreement that innovative new research tools are required to better understand the incredible structural and functional complexity of the brain. To this aim, optical techniques based on genetically encoded neural activity indicators and actuators have represented a revolution for experimental neuroscience, allowing to get a dynamic picture of the brain in action. Recently, a great amount of research has been devoted to obtain “multifunctional” devices, exploiting micro- and nano-structures to deliver and collect light from the brain, to record electrical activity from single or multiple cells and to locally release drugs [1-4].

After a review of the state-of-the-art in this field, this presentation will focus on the engineering and use of multimodal tapered optical fibers for interfacing with the brain. We will describe our approach to obtain minimally invasive multipoint optical control and monitoring of neural activity, based on a mode division multiplexing/demultiplexing approach. Exploiting micro and nanotechnologies to structure non-planar surfaces, tapered fibers also allow the integration of electrodes for extracellular readout of neural activity, representing an important complement to currently available technologies [5-7].

References

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