Cite this as: Sara PIMENTA, João R. FREITAS, José H. CORREIA. Flexible neural probes: a review of the current advantages, drawbacks, and future demands[J]. Journal of Zhejiang University Science B, 2024, 25(2): 153-167. http://doi.org/10.1631/jzus.B2300337

Flexible neural probes: a review of the current advantages, drawbacks, and future demands

Key words: Brain knowledge; Flexible interfaces; Multifunctional probes

Research Summary

This review aims to provide an overview of the fabrication, characterization, and validation of several types of flexible neural probes, exploring the main advantages and drawbacks of these devices. Future developments and applications are also covered. Overall, this review aims to present the currently available flexible devices and future appropriate avenues for development as possible guidance for future engineered devices.

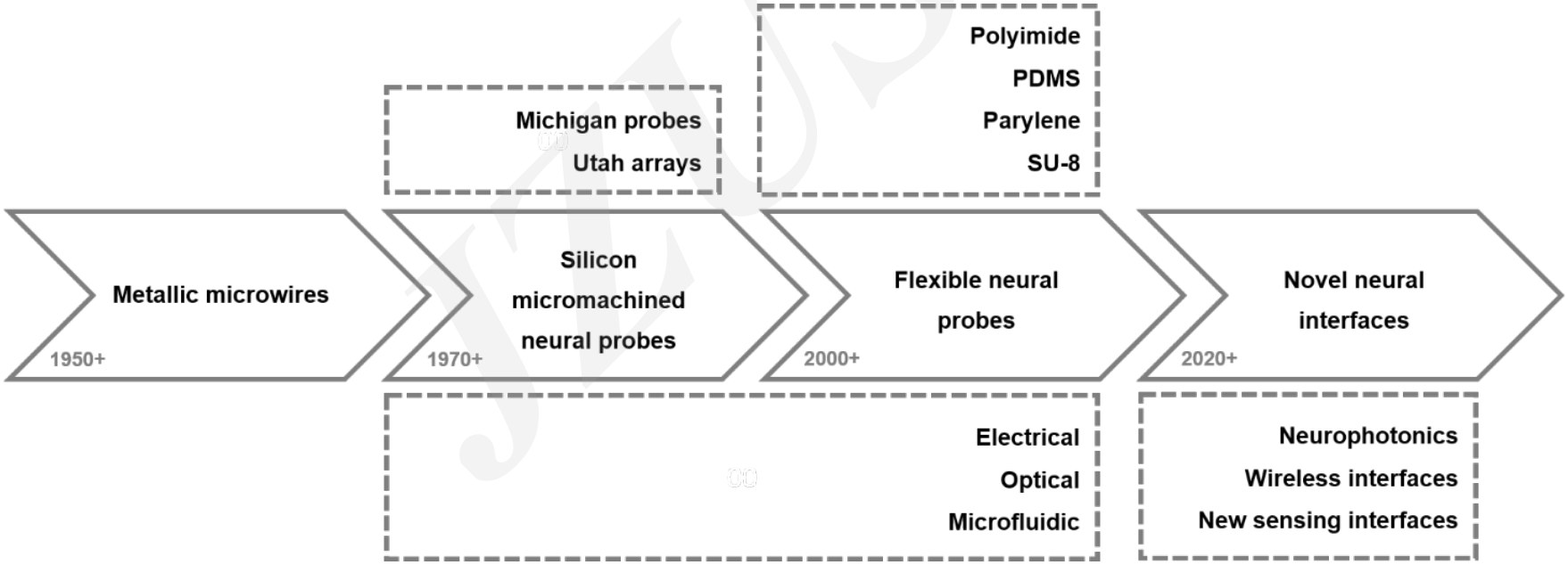

Fig. 1 Overview of the evolution of neural devices.

Innovation points

- **SUMMARY of the developed flexible neural probes, covering multiple functions and applications:**
  - **Electrical**
  - **Optical**
  - **Microfluidic**

- **PRESENTATION of a series of figures to summarize the different types of flexible neural probes:**
  - **Fig. 2 – Illustration of electrical flexible neural probes**
  - **Fig. 3 – Artwork of optical flexible neural probes**
  - **Fig. 5 – Illustration of a microfluidic flexible neural probe**

Innovation points

- **EMPHASIS in future developments and applications, showing the artwork of a neurophotonic interface (Fig. 6)**

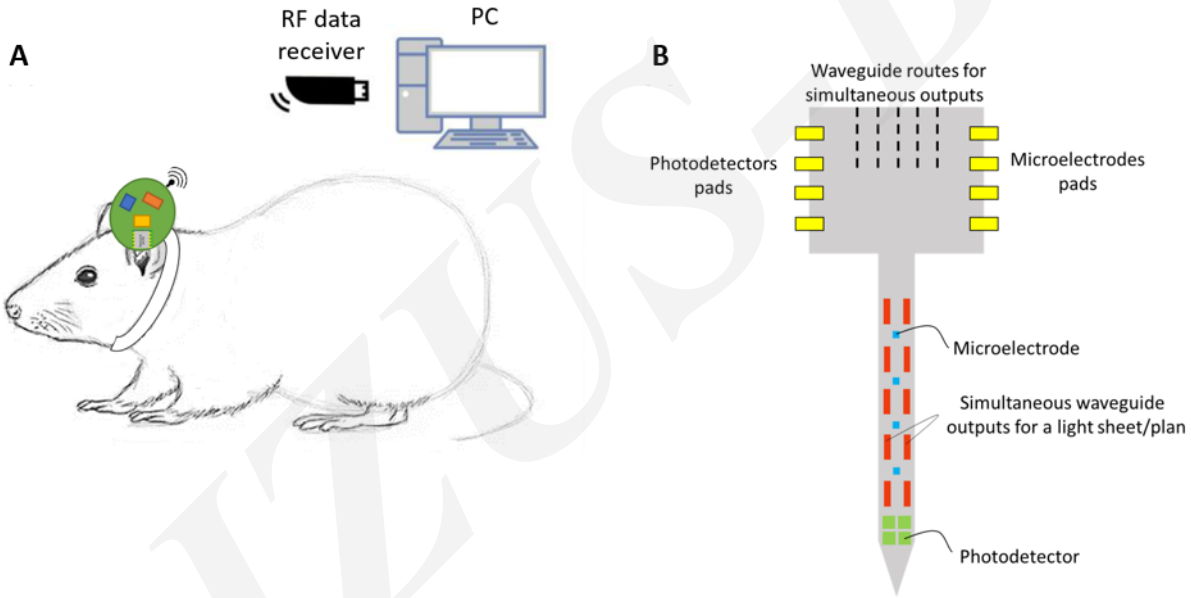

Fig. 6 (A) Artwork of a neurophotonic interface. A reduced dimension and lightweight PCB is fixed on the rat's head with the optical source (that will provide the light for waveguide routes) and all the control, readout, and communication electronics. The neural probe will be coupled to this PCB through wirebonding of pads. (B) Neural probe to be inserted into the rat's brain. The number of elements (microelectrodes, photodetectors, and simultaneous waveguides outputs) is merely representative. Each waveguide route can lead to 2 simultaneous waveguide outputs for a specific illumination plane.