Liquid-crystal polymer

Liquid-crystal polymers (LCPs) are a class of aromatic polymers. They are extremely unreactive and inert, and highly resistant to fire.

Chiang et al. described the development, validation, and dissemination of flexible, high-resolution, thin-film (TF) electrodes for recording neural activity in animals and humans.

They leveraged standard flexible printed-circuit manufacturing processes to build high-resolution TF electrode arrays. They used biocompatible materials to form the substrate (liquid-crystal polymer; LCP), metals (Au, PtIr, and Pd), molding (medical-grade silicone), and 3D-printed housing (nylon). They designed a custom, miniaturized, digitizing headstage to reduce the number of cables required to connect to the acquisition system and reduce the distance between the electrodes and the amplifiers. A custom mechanical system enabled the electrodes and headstages to be pre-assembled prior to sterilization, minimizing the setup time required in the operating room. PtIr electrode coatings lowered impedance and enabled stimulation. High-volume, commercial manufacturing enables cost-effective production of LCP-TF electrodes in large quantities.

The LCP-TF arrays achieve 25× higher electrode density, 20× higher channel count, and 11× reduced stiffness than conventional clinical electrodes. They validated this LCP-TF electrode in multiple human intraoperative recording sessions and have disseminated this technology to >10 research groups. Using these arrays, they observed high-frequency neural activity with sub-millimeter resolution.

This LCP-TF electrodes will advance human neuroscience research and improve clinical care by enabling broad access to transformative, high-resolution electrode arrays [1)]

1)
Chiang CH, Wang C, Barth K, Rahimpour S, Trumpis M, Duraivel S, Rachinskiy I, Dubey A, Wingel KE, Wong M, Witham NS, Odell TG, Woods V, Bent B, Doyle W, Friedman D, Bihler E, Reiche CF, Southwell D, Haglund MM, Friedman AH, Lad S, Devore S, Devinsky O, Solzbacher F, Pesaran B, Cogan G, Viventi J. Flexible, high-resolution thin-film electrodes for human and animal neural research. J Neural Eng. 2021 May 19. doi: 10.1088/1741-2552/ac02dc. Epub ahead of print. PMID: 34010815.