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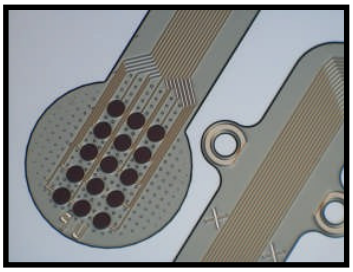
Multielectrode Arrays on Flexible Polyimide

Neural Stimulation, Neural Recording, Biosensors



Multielectrode Arrays

EIC Biomedical offers custom-fabricated multielectrode arrays on flexible polyimide substrates. The arrays are designed for recording and stimulation of neural tissues. The arrays are suitable for laboratory studies and for acute and chronic animal studies. Fabricated on flexible polyimide using advanced materials and thin-film processing techniques, the arrays provide unmatched design flexibility, optimum electrode properties, and long-term *in vitro* and *in vivo* stability.

Flexibility in Design

The wide range of options available allows the user to customize an array to meet individual needs:

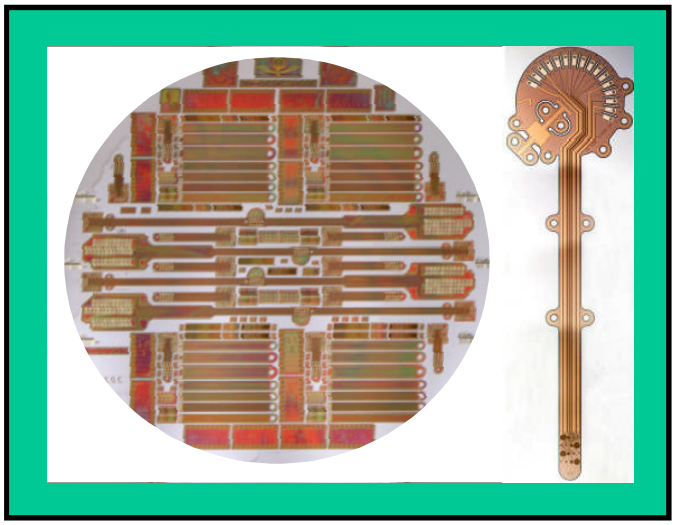
Array Thickness An array thickness of 8 µm or greater is available. Standard processing produces arrays having a thickness of 10-14 µm. Thicker arrays are available.

Array Size Any size array that fits within a 90 mm diameter circle can be fabricated.

Interconnect Metallization Metal interconnection lines and contact pads are typically gold. Platinum and iridium are also available.

Recording and Stimulation Electrode Arrays

- Custom design of multielectrode arrays for recording and stimulation
- Array dimensions up to 90 mm
- Wide range of electrode number and size
- Low impedance electrode coatings
- Exceptional *in vitro* and *in vivo* stability
- Laboratory and chronic animal connectors
- Biocompatible array materials

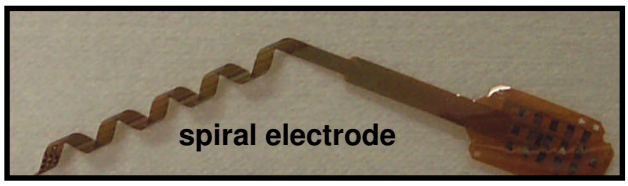


Electrode Material A variety of corrosion resistant and low impedance coatings is available including: gold, platinum, iridium oxide, and titanium nitride.

Electrode Size The minimum electrode size is approximately 100 µm^2. There are no restrictions on the shape or maximum size of an electrode.

Electrode Number There is no limit to the number of electrodes on an array other than the practical constraints of interconnect metallization and electrical connection.

Shaped 3-D Arrays Arrays with cuffs, spirals and other non-planar geometries that conform to tissue surfaces or wrap around nerves are available.



Electrical Connections to the Array

Electrical connections to arrays for laboratory and acute animal studies are made with interconnect hardware that terminates in a standard ribbon cable connector. For animal implants, arrays are integrated with multiwire cables that are optionally terminated with a percutaneous connector for chronic studies.

Electrode Characterization

EIC Biomedical offers detailed electrochemical characterization of electrodes on arrays. The characterization focuses on those properties relevant to neural recording and stimulation and includes:

Cyclic Voltammetry This low-current process is used to estimate the available charge for current pulsing (charge-storage-capacity) and to provide information on reduction-oxidation processes occurring at the electrode.

Impedance Spectroscopy Electrode impedance is measured over a broad frequency range to assess likely neural recording performance and to provide an indication of charge-injection capacity.

Charge-injection Capacity Voltage transients are measured during stimulation pulsing to determine electrode polarization, which is then compared with established polarization limits for avoiding electrode damage or irreversible reactions harmful to tissue.

Other available electrochemical techniques include:

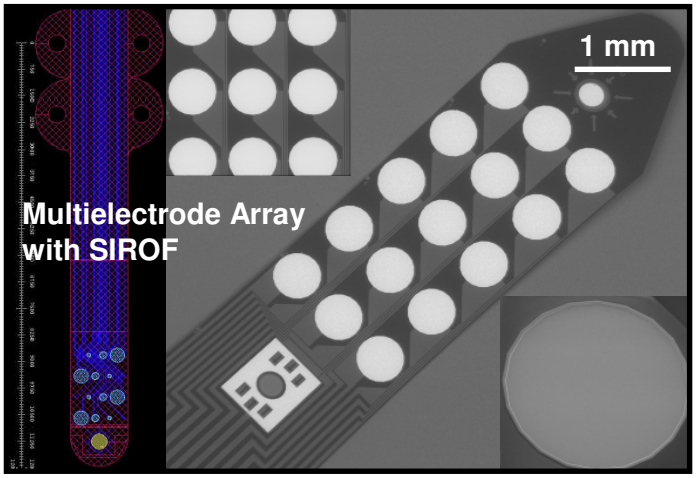
- Potentiodynamic polarization – for corrosion studies
- Chronoamperometry – for biosensor measurements
- Potentiostatic polarization – for corrosion studies

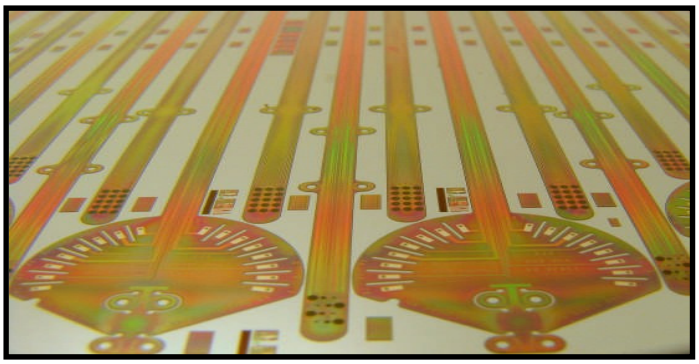
Array Stability

EIC Biomedical offers arrays with enhanced stability for prolonged immersion in physiological electrolytes and for extended chronic implantations. These high-stability arrays tolerate 20 weeks at 87°C in saline with preservation of electrode function and, with sputtered iridium oxide coatings (SIROFs), have demonstrated stability over 2 years of continuous stimulation current pulsing *in vitro* at charge densities of 900 $\mu C/cm^2$.

Sterilization

Multielectrode arrays may be sterilized by autoclaving, UV radiation, alcohol immersion, or ethylene oxide gas.





Storing Multielectrode Electrodes

Arrays are stored dry indefinitely. Wet storage in distilled water or dry storage after thorough cleaning with distilled water is recommended if arrays are being reused.

Multielectrode Arrays at EIC Biomedical

EIC Biomedical works with sponsors to design multielectrode arrays to meet the needs of their application. The design and fabrication process includes:

- assisting in array design;
- CAD work and mask design for photolithography;
- selection of electrode coatings;
- optical and scanning electron microscopy of arrays;
- electrochemical characterization of electrodes including: cyclic voltammetry, impedance spectroscopy, and charge injection capacity;
- long-term *in vitro* pulsing and stability studies.

For more information about multielectrode polyimide arrays please contact us at:

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Limitations

The suitability and safety of multielectrode arrays provided by EIC Biomedical is the responsibility of the end-user. EIC Biomedical does not guarantee the performance of the multielectrode arrays except as provided in a written good faith estimate to the end-user at the time of order. The end-user is cautioned that the long-term stability and performance of the arrays will vary with geometry, size, selection of materials of construction, on the manner in which the array is used; and other factors that may not be readily predicted. The end-user is further cautioned that the use of the arrays in an animal is subject to many uncertainties and no warranty as to *in vivo* performance is given or implied. This product is not intended for permanent use in humans.

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