University of Michigan
Carbon Fiber Array Catalog

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Introduction

This catalog details the available arrays provided by the Chestek lab through a NeuroNex MINT distribution grant (NSF 1707316). If you would like to request devices or have additional questions, please email Paras Patel (parasp@umich.edu).
**General Information**

All arrays are made with carbon fibers with a diameter of 6.8µm.

All arrays, unless requested otherwise, come with the following standard configuration:

- An insulation coating of Parylene C with an approximate thickness of 800nm, before tip functionalization.
- Pure silver ground and/or references wires. The wires are 50mm long with 20mm exposed at the end.
**HDCF Array**

The high density carbon fiber (HDCF) array is a combination of a silicon support shuttle or shanks with 16 carbon fibers. The tapering shanks provide permanent mechanical support during the insertion of the carbon fibers. The fixed portion of silicon + carbon fiber comes in 3mm, 6mm, or 9mm lengths. The protruding portion of carbon fiber can be cut to any length (typically 100-300µm) and the tips functionalized to meet different application needs. The arrays can be attached to different interface boards that are compatible with commercially available recording hardware.
Carbon Fiber Numbering

The diagram below indicates the numerical order of the carbon fibers which is used for all related documentation and mapping. The image below assumes the front of the device is facing the user and the fibers are pointing down.
Silicon Shank Dimensions

The exact dimensions of the tapering silicon shanks are shown below.

3mm HDCF Array

Carbon fiber (d=8.4μm w/Parylene C) running along the silicon shank and protruding from the end.

6mm HDCF Array

Carbon fiber (d=8.4μm w/Parylene C) running along the silicon shank and protruding from the end.

9mm HDCF Array

Carbon fiber (d=8.4μm w/Parylene C) running along the silicon shank and protruding from the end.
Interface Board Specifications and Connector Mapping

Interface boards provide the backend connections to the different HDCF arrays. Any size array can be paired with any interface board listed below.

18-pin Omnetics Interface Board

**Connector:** 18-pin Omnetics (A79040-001)

**Dimensions:** 7.4mm (w) x 12.1mm (h)

**Weight:** ~0.26g

**Electrophysiology Headstage Compatibility:**
- Intan RHD 16ch
- Intan RHS 16ch

Carbon fiber number mapping for the above interface board. See headstage manufacturer’s documentation for corresponding channel mapping.
ZIF Interface Board

**Connector:** 20-pin Hirose (DF30FC-20DS-0.4V(82))

**Dimensions:** 7mm (w) x 11mm (h)

**Weight:** ~0.23g

**Electrophysiology Headstage Compatibility:**
- Tucker-Davis Technologies ZC16
- Tucker-Davis Technologies ZC32
- Tucker-Davis Technologies ZD32

Carbon fiber number mapping for the above interface board. See headstage manufacturer’s documentation for corresponding channel mapping.
**Flex Array v3 (legacy)**

The flex array consists of a flexible polyimide board with 16 carbon fibers protruding from the end. The board's polyimide shank length is fixed at 10mm. The protruding portion of carbon fiber at the end of the board can be cut to any length (typically 150-500µm) and the tips functionalized to meet different application needs.

**Connector:** 36-pin Omnetics (A79024-001)

**Dimensions:** 14mm (w) x 19.2mm (h)

**Shank Length:** 10mm

**Weight:** ~0.26g

**Electrophysiology Headstage Compatibility:**
- Intan RHD 32ch (32 unipolar)

**Carbon Fiber Configuration:**
- Up to 16 fibers in two rows of 8
- 132µm pitch within a row
- 50µm between rows of fibers
- Fiber length 150-500µm
Carbon Fiber Numbering

The diagram below indicates the numerical order of the carbon fibers which is used for all related documentation and mapping. The image below assumes the front of the device is facing the user and the fibers are pointing down. The top/front row of fibers are numbered 1 through 8 in sequential order. The bottom/back row of fibers are numbered 9 through 16 in sequential order.
**Connector Mapping**

Carbon fiber number mapping for the flex array. See headstage manufacturer's documentation for corresponding channel mapping. Note, two traces/pins are connected to each fiber, therefore there is a redundancy in the mapping.

GND = Ground  
REF = Reference
Flex Array v4 (legacy)

The flex array consists of a flexible polyimide board with 16 carbon fibers protruding from the end. The board’s polyimide shank length is fixed at 3mm. The protruding portion of carbon fiber at the end of the board can be cut to any length (typically 150-500µm) and the tips functionalized to meet different application needs.

Connector: 36-pin Omnetics (A79024-001)

Dimensions: 14mm (w) x 12.2mm (h)

Shank Length: 3mm

Weight: ~0.26g

Electrophysiology Headstage Compatibility:
- Intan RHD 32ch (32 unipolar)

Carbon Fiber Configuration:
- Up to 16 fibers in two rows of 8
- 132µm pitch within a row
- 50µm between rows of fibers
- Fiber length 150-500µm
Carbon Fiber Numbering

The diagram below indicates the numerical order of the carbon fibers which is used for all related documentation and mapping. The image below assumes the front of the device is facing the user and the fibers are pointing down. The top/front row of fibers are numbered 1 through 8 in sequential order. The bottom/back row of fibers are numbered 9 through 16 in sequential order.
**Connector Mapping**

Carbon fiber number mapping for the flex array. See headstage manufacturer's documentation for corresponding channel mapping. Note, two traces/pins are connected to each fiber, therefore there is a redundancy in the mapping.

GND = Ground  
REF = Reference

Omnetsics Lettering or Probe Number

Flex Array
**Tip Functionalization**

The tips of the carbon fibers can be functionalized according to the end user's application. All fibers are coated with Parylene C before the tip functionalization step. All fibers undergo a plasma ashing step to remove residual Parylene C and/or debris prior to the final plating or just after the final ablation step. Note, only one tip functionalization method can be applied per array.

**Laser Cut**

- **Application**: Electrophysiology
- **Exposed Length**: 10µm
- **Plasma Ashing**: Yes
- **Plating**: PEDOT or PtIr
- **References**: Welle et al., Journal of Neural Engineering, 2020

**Blowtorch Sharpened**

- **Application**: Electrophysiology and/or Stimulation
- **Exposed Length**: 50-100µm
- **Plasma Ashing**: Yes
- **Plating**: PEDOT or PtIr (required for stimulation)
- **References**: Welle et al., IEEE TNSRE, 2021; Huan et al., Journal of Neural Engineering, 2021
Laser Ablation

**Application:** Fast Scan Cyclic Voltammetry

**Exposed Length:** 50-100µm

**Plasma Ashing:** Yes

**Plating:** None

**References:** Patel et al., Journal of Neural Engineering, 2020
FAQs
Answers to some frequently asked questions regarding all of our arrays.

Can these arrays be sterilized?
Yes, these arrays can be sterilized using ethylene oxide. If you do choose to sterilize using ethylene oxide, you can keep them in the original box. We do not recommend using steam sterilization.

Can these arrays be re-used?
Yes, labs have reused these devices in acute/non-survival preparations.

What are the ground and reference wires?
The wires are 50mm long Teflon coated silver wire (AWG 36) with 20mm exposed at the end.
References

HDCF Array


Flex Array


