

Materials List for:

Fabrication of Ti₃C₂ MXene Microelectrode Arrays for *In Vivo* Neural Recording

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Materials

Name	Company	Catalog Number	Comments
00-90 screw	McMaster-Carr	90910A630	Skull screw around which ground wire is wrapped
128ch stimulation/recording controller	Intan Technologies		A component of the neural recording system.
175 mL polypropylene (PP) conical centrifuge tubes	Falcon	REF: 352076	Used for washing
18 position 0.5 mm pitch ZIF connector	Molex	505110-1892	Used to interface the flexible Parylene microelectrode array with the PCB adapter board.
18 position dual row male nano-miniature (.025"/.64mm) connector	Omnetics Connector Corporation	A79008-001	Used to interface the PCB adapter board to the recording headstage.
3ML Disposable Plastic Set Transfer Graduated Pipettes	Rienar	Rienar-3ML-20PCS	Used for transferring etchant or MXene solutions
50 mL polypropylene (PP) conical centrifuge tube	Falcon	REF: 352070	Used for washing and size selection
Al etchant Type A	Transene	060-0026000-QT	For removing Al etch mask layer after final Parylene-C etch.
Aluminum Powder, -325 Mesh, 99.5% (metals basis), particle size < 44 μm	Alfa Aesar	CAS: 7429-90-5	Used for MAX synthesis
AutoCAD software	Autodesk Inc.		Design software for drawing photomasks. Free alternatives include DraftSight and LayoutEditor.
Buffered Oxide Etchant 6:1	JT Baker	1178-03	For removing SiO ₂ layer to expose MXene electrode contacts at the end of the fabrication procedure.
Buprenorphine SR	Wildlife Pharmaceuticals		Analgesia for rat surgery
Centrifuge	Hermle	Benchmark Z 446	Used for washing and size selection
Dexdomitor	Midwest Veterinary Supply	193.13250.3	Anesthesia for rat surgery
Drill burr	Fine Science Tools	19007-07	Burrs for drill
Electric drill	Foredom	K.1070	Micromotor drill for craniotomies
Electron beam evaporator	Kurt J. Lesker Company		Used to evaporate Ti, Au, and SiO ₂ during fabrication. Most

			university clean rooms have this or a similar tool.
Ground wire	A-M Systems	781500	Bare silver wire
Headspace Vial, glass	Supelco	REF: 27298	Used for storing MXene solutions
Hydrochloric acid (12.1N)	Fisher Scientific	CAS: 7647-01-0	Corrosive; etchant material
Hydrofluoric Acid, (48-51% solution in H ₂ O)	Acros	CAS: 7664-39-3	Etchant material
Jupiter II RIE system	March Plasma Systems Inc.		Planar RIE etching system used to etch the Parylene-C using O ₂ plasma. Most university clean rooms have a comparable planar RIE etching system.
Kapton standard polyimide tape, 1/4"	DuPont		Used to add thickness to the Au bonding pad region of the flexible Parylene microelectrode array for insertion into the ZIF connector.
Ketamine	Hospital of the Univ. of Penn.		Anesthesia for rat surgery
KLA P-7 Stylus Profilometer	KLA Corporation		Used to measure 2D profiles to confirm complete etching through the sacrificial parylene-C layer in step 2.4.2. Most university clean rooms have this or a comparable stylus profilometer tool.
Lithium chloride, 99% for analysis, anhydrous	Acros	CAS: 7447-41-8	Hygroscopic; delamination material
MA6 mask aligner	Karl Suss Microtec AG		Used to align each photomask to the pattern on the wafer and expose the wafer to UV light. Most university clean rooms have this or a similar tool.
Micro-90 cleaning solution	International Products Corporation	M-9050-12	Used as the anti-adhesive layer to enable removal of the sacrificial Parylene-C layer to pattern the MXene
NR71-3000p photoresist	Futurrex Inc.	NR71-3000p	Negative photoresist used to define Ti/Au traces and MXene patterns in the devices.
Ophthalmic ointment	Midwest Veterinary Supply	193.63200.3	To prevent corneal drying during surgery
Parylene deposition system	Specialty Coating Systems		Used to evaporate thin conformal films of Parylene-C
Parylene-C dimer	Specialty Coating Systems	980130-c-01lbe	Flexible polymer used as bottom and top passivating layers for the flexible MXene devices
Photomasks (chrome on soda lime glass)	University of Pennsylvania		Our photomasks were produced in the University clean room using a Heidelberg DWL66+ laser writer system, however several vendors manufacture photomasks from provided design files.
Povidone-iodine solution	Medline	MDS093901	To help prevent infection around scalp incision
Printed Circuit Board (PCB)	Advanced Circuits		Used to interface between the MXene electrode array and the measurement electronics such as the potentiostat and the Intan recording system. Advanced Circuits and other vendors manufacture and assemble PCBs based on the provided design files.

RD6 Developer	Futurrex Inc.	RD6 Developer	Used to develop NR71-3000p negative photoresist following UV exposure
Reference 600 potentiostat	Gamry Instruments		Used to measure the electrodes' impedance to assess quality of the devices
Remover PG	MicroChem Corp.	G050200	Used to remove NR71-3000p following metal deposition to perform lift-off patterning
RHS2000 Stim SPI interface cable	Intan Technologies		A component of the neural recording system.
RHS2116 amplifier board	Intan Technologies		A component of the neural recording system.
Si wafers	Wafer World	2885	Substrate for fabrication
Spin Coater	Cost Effective Equipment		For coating wafers with resists and applying the Micro-90 and MXene layers. Most university clean rooms have spin coaters.
Stereotaxic frame	Kopf Instruments	Model 902	For positioning the rat for neurosurgery
Teflon-coated magnetic stir bar	Corning	REF: 1233W95	Used to stir during etching and intercalation
Titanium carbide, 99.5% (metals basis), particle size ~2 μm	Alfa Aesar	CAS: 12070-08-5	Used for MAX synthesis
Titanium powder, -325 mesh, 99% (metals basis), particle size < 44 μm	Alfa Aesar	CAS: 7440-32-6	Used for MAX synthesis
Ultrasonic bath sonicator	Reynolds Tech		For removing metal and photoresist particles during lift-off processes to pattern metals.
UV vis spectrophotometer	ThermoScientific	Evolution 201	Used to determine concentration and observe absorption peak
Zetasizer, Particle Size Analysis	Malvern Panalytical	Nano ZS	Used to determine particle lateral size distribution