Neural Interfaces

NX-422

Summary

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Materials and technologies recap'

material	properties		
polyimide	Form factor	Resin foil	Spin-coating + curing (350C, h, N2 env)
		thickness	10-100um
	Hermeticity	limited	
Orange thermoplastic	E	2.5 GPa	Plastic deformation, strain > 5%
	CTE	20-60 ppm/C	
	Electrical insulation	3 (dielectric constant)	Use as substrate and/or encap.
	etch	Dry etching (O2) Wet etching (KOH)	Laser micromachining
	Non toxic		

Materials and technologies recap'

material	properties		
Parylene	close to PI		
	Elastic modulus	~2-3GPa	
	processing	CVD (chem. vapor dep. At room temperature)	Conformal, 3D
	Optical prop	Transparent in the visible range	
	CTE	~35 ppm/C	
	Dielectric constant	~2.65	
	patterning	Dry O2 based etching	

Materials and technologies recap'

material	properties		
Silicon (crystalline)	semiconductor	wafer	
	Critical strain	0.05%	brittle
	Elastic modulus	140GPa	
	processing	Transfer printing	
	Optical prop	Opaque (vis range)	
	CTE	2.6-3.3 ppm/C	
	Dielectric constant	11.7	
	patterning	RIE (F-based) Wet etching (KOH, HF)	

Materials and technologies recap'

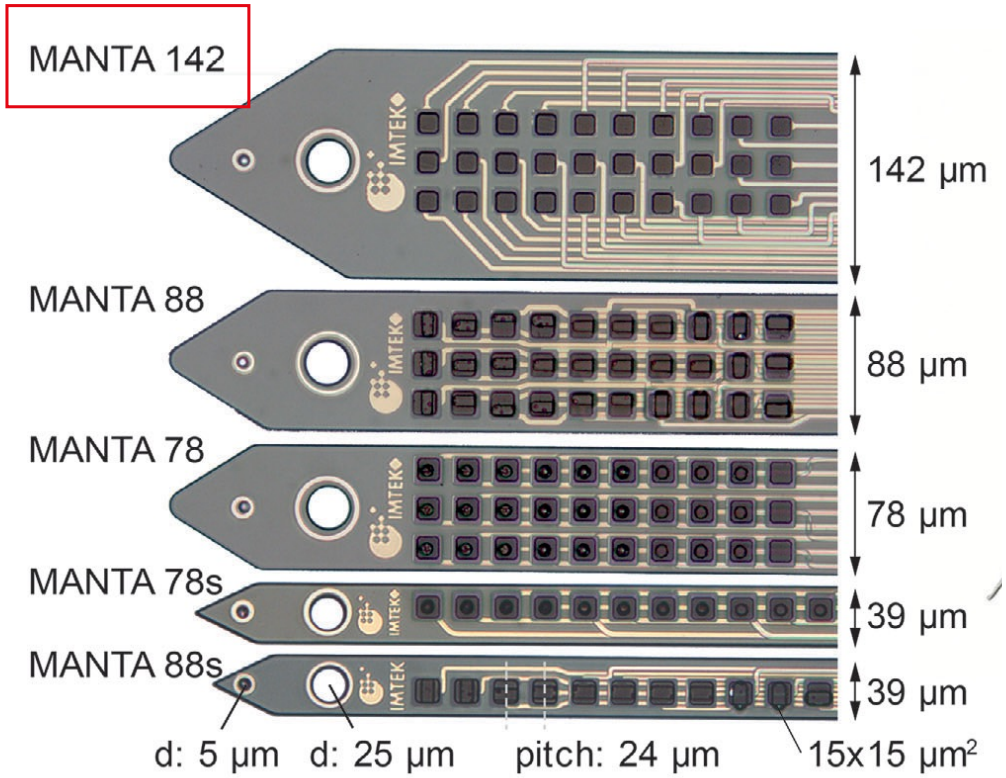
material	properties		
platinum	metal		100-300nm
	Ductile material	Plastic deformation	
	Electrical resistivity	10s uOhm.cm	
	Young modulus	170 GPa	
	Deposition technique	Sputtering, evaporation	Thin film
		Electroplating (electrode only)	porous
	Etching	Wet etching Dry etching, ablation Lift-off	
	Needs an adhesive layer		

Materials and technologies recap’

material	properties		
Silicone	elastomer	Highly viscous before crosslinking	
	Elastic modulus	10 kPa – 10 MPa	
	processing	spin-coating Injection molding	Curing in air from RT to 150C
	Optical prop	Transparent (vis. range)	
	CTE	300 ppm /C	
	Dielectric constant	2	
	patterning	RIE (F based) Laser micromachining	

Polyimide based shank with high density electrodes

Analyse the photos.
Propose the list of materials.
Prepare cross-sections.
Propose a process flow.



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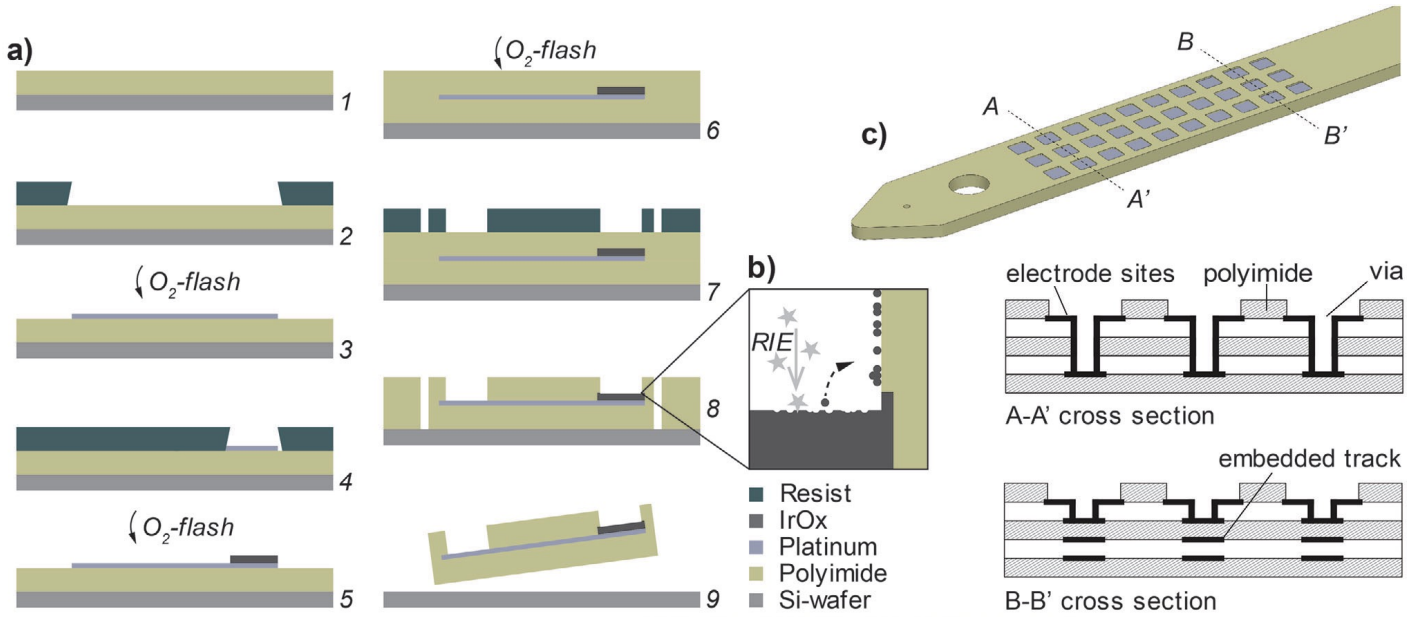
Polyimide based shank with high density electrodes



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Polyimide based shank with high density electrodes

*MANTA probes were fabricated by advancing **standard PI fabrication** protocols to a multilayer design, comprising ultimately **5 PI and 7 metallization layers** in a probe of **10 µm thickness**.*

*First a **2µm thin layer of PI** (U-Varnish S, UBE corporation) was spincoated onto a carrier wafer and cured at 450°C under nitrogen atmosphere (YES- 450PB8-4PB/E, Yield Engineering Systems Inc.).*
***A liftoff-resist** (AZ5214E, MicroChemicals GmbH) was subsequently used to pattern the first **Pt layer** (100 nm, static evaporation, Univex 500, Leybold).*
*Prior to the **metal deposition**, the PI-surface was activated in an O2-plasma (30 s at 100 W, STS-RIE) to ensure stable adhesion between the layers.*
*After another O2-plasma treatment, this metal layer was insulated with **a second PI layer** (2 µm), which was then partially opened by reactive ion etching using an O2-plasma (100 W, STS-RIE) and a resist mask (AZ9260, MicroChemicals GmbH) to define the **first set of vias**.*
*A **second Pt-layer** was afterward deposited (following again an O2-plasma treatment and using the same parameters as previously described) to define the tracks and electrodes in the second metallization plane.*
*The **electrode sites** were additionally coated with a sputtered iridium oxide (**SIROF**) layer (800 nm, 100 W, 15 sccm O2, Univex 500, Leybold) using again a **lift-off resist** to define the electrode geometry.*
*The **same process steps** (O2-plasma, Pt + SIROF-deposition, and PI-insulation) **were repeated twice** to build up a total stack of **5 PI layers with 4 Pt-metallization planes** and three SIROF layers.*
The topmost PI-layer was finally patterned using RIE to realize simultaneously the electrode openings above the SIROF sites, to open the Pt-pads for solder interconnection at the backend of the probe, as well as to define the overall outline of the probe.
For further use and characterization, probes were individually peeled off from the carrier wafer.

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Polyimide based shank with high density electrodes

Electrode characterization