

☐ Semestral Project ☐ Master Project ☐ Thesis ☒ Other

MICRO-501 ELECTROTHERMAL MICROACTUATORS

Description of the fabrication project

Fabrication of SiO₂ cantilevers with Cr tracks for electrothermal actuation for the class MICRO-501 MEMS Practicals I (J. Brugger, G. Boero, A. Bertsch). The teaching assistants are CMi users and will take groups of 2-3 Master students to CMi for the fabrication sessions.

Mixed reality assisted teaching will be conducted during PR coating, soft baking, and PR exposure. Permission of bring Hololens, laptop, and camera will be asked every time the day before the TP.

Technologies used <i>!! remove non-used !!</i>			
Mask fabrication, evaporation, positive resist, wet etching.			
Photolitho masks			
Patterning#	Critical Dimension	Critical Alignment	Remarks
1	3 um	First Mask	Cr structuration – MASK LAYER 1 METAL
2	20 um	2 um	SiO ₂ structuration - MASK LAYER 2 OXIDE
Substrate Type and size			
Silicon <100> test wafer, Ø100mm, 525um thick, Single Side polished.			

Interconnections and packaging of final device

Thinning/grinding/polishing of the samples is required at some stage of the process.

☒ No ☐ Yes => confirm involved materials with CMi staff

Dicing of the samples is required at some stage of the process.

☒ No ☐ Yes => confirm dicing layout with CMi staff

Wire-bonding of dies, with glob-top protection, is required at the end of the process.

☒ No ☐ Yes => confirm pads design (size, pitch) and involved materials with CMi staff

Step-by-step process outline

Step	Process description	Cross-section after process
01	Substrate: <i>Si test</i> Wafer preparation & wet oxidation (by CMi) * RCA cleaning * Wet oxidation SiO ₂ (1.5 μm) <i>Machines: Plade RCA, Centrotherm furnaces</i>	
02	Metal deposition by PVD (by CMi) * Cr evaporation (500 nm) * E-beam source <i>Machine: EVA760 Z11</i>	
03	Cr Mask fabrication/exposure <i>Machine: Heidelberg Instruments VPG200, i-line photoresist laser writer Z05</i>	
04	Cr Mask PR development, Cr etching, and PR stripping <i>Machine: Hamatech HMR900, mask (Cr-blanks) processing equipment Z06</i>	
05	Photolithography to pattern heaters (with students) * Spin coating AZ1512 HS * Soft baking @ 100 °C, 75 s * UV exposure * Development <i>Machines: HMDS hotplate Z13, SSE SB20 coater line Z13, Ceram hotplate Z13, MJB4 Z13, Base wet bench Z13, Microscopes Z13</i>	
06	Cr etch (A2 with students) * Cr wet etching * Resist stripping * Resistance measurement <i>Machine: Acid bench Z14 (Cr etch), PR stripping Z12 (or UFT Resist Z2), MPI TS150 Prober station Z11</i>	

07	Photolithography to pattern beams (A3 with students) * Spin coating AZ1512 HS * Soft baking @ 100 °C, 75 s * UV exposure with alignment * Development <i>Machines:</i> <i>HMDS hotplate Z13, SSE SB20 coater line Z13, Ceram hotplate Z13, MJB4 Z13, Base wet bench Z13, Microscopes Z13</i>	
08	SiO₂ etch (A3 with students) * O ₂ plasma descum (no Cr exposed, program 45 @ 200 W 10 s) * Oxide wet etching by HF (BOE) * Resist stripping * Cr and SiO ₂ thickness measurement <i>Machine: Tepla 300 Z11, Acid bench Z14 (BOE), PR stripping Z12 (or UFT Resist Z2), Bruker Dektak XT Z15</i>	
09	Si etch and cantilever release (by teaching assistants) * Anisotropic wet Si etching in KOH <i>Machine: Base wet bench Z14 (KOH 23% at 80°C for 50 min), Solvent wet bench Z14 (for drying out with IPA to avoid cantilevers pinning down)</i> * Alternative process: isotropic dry etching. <i>Machine Alcatel AMS Z2</i>	

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CMi EPFL Center of
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SEM imaging (by teaching assistants)
Machine: SEM Merlin Z15

