Appendix 4: Most Commonly Encountered Materials

The most commonly encountered materials in MEMS for beginning students are summarized below, together with the representative conditions under which they are formed, the most common preferential etchant or etching method, and the highest temperature the material can withstand in a process.

Material	Representative forming condition	Common preferential etchant or etching method	Practical temperature tolerance in a process [i]
Gold thin film	Metal evaporation under room temperature and vacuum	Gold film etcher	~ 400°C (melting temperature=1064°C)
Aluminum thin film	Metal evaporation under room temperature		~200°C (melting temperature=660°C)
LPCVD silicon nitride	Hot wall, low pressure, 800°C.	Hot 180°C H_3PO_4 solution	~1200°C
LPCVD polycrystalline silicon	Hot wall, low pressure, 600°C.	Plasma etch	~1200°C
LPCVD low temperature oxide	Hot wall, low pressure, 550°C.	Hydrofluoric acid	~1200°C
Thermally grown silicon dioxide	900-1200°C	Hydrofluoric acid	~1200°C
Photoresist (after lithography patterning)	Spin coating followed by development and hardbake at 80-120°C	Photoresist developer	Reflows (softens) at ~100°C
		Oxygen plasma	
		Oxidizing wet chemical (e.g., Piranha)	
		Organic solvent Acetone	
Parylene	Chemical vapor deposition under room temperature	None. Can be removed by oxygen ashing at elevated temperature.	120°C
Polydimethylsiloxane (PDMS)	Cast molding followed by curing (R.T. or 100°C elevated temperature)		200°C
Single crystal silicon substrate	Melting (>1414°C) and recrystalization	Wet chemical EDP	~1200°C
		Wet chemical KOH	
		Gas etchant XeF2	

[i] At high temperature and extended exposure time, a material may experience phase change, chemical reactions in the interior or on surface, and structural change. A material may be damaged, weaken, deform, oxidized, or react with neighboring layers. The temperature suggested in this column is a practical suggestion combining all these risks. It is not meant to be a precise and exhaustive "safety guideline" for processing, but rather its main purpose is to help new students to the MEMS field to develop a qualitative understanding about limits of materials.