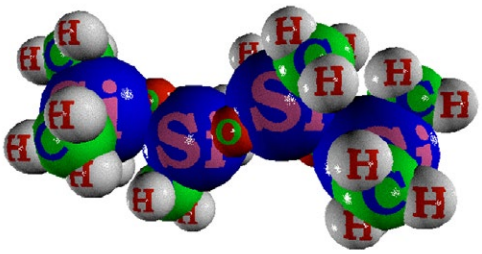
DOWSIL™ Silicone NIL (Nano-Imprinting Lithography) mold materials

The unique properties of silicones



Molecular characteristics

- Highly open, flexible and mobile backbone
- High bond strength: 435 kJmol-1 Si-O, cf. 350 kJmol-1 C-C

Physico-chemical properties

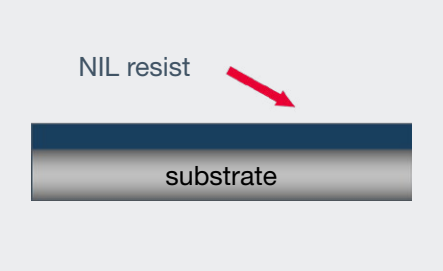
- Low surface tension and energy
- High spreading and wetting capabilities
- Permeable to gas and water vapour
- Heat stability
- Degradability
- Compatibility with organics
- Weather resistance
- Low glass transition temp.

Applications

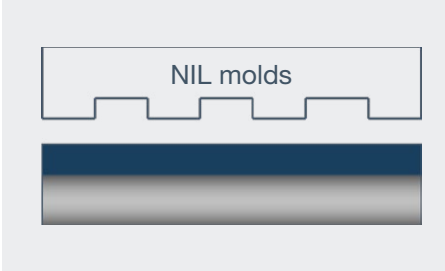
- Lubricant
- Antifoam agent
- Release agent
- Aesthetic feel (softness)
- Comfort
- High temperature processing
- Can be sterilized
- Hydrophobic / hydrophilic
- Breathable

Nanoimprint process (heat or UV cure)

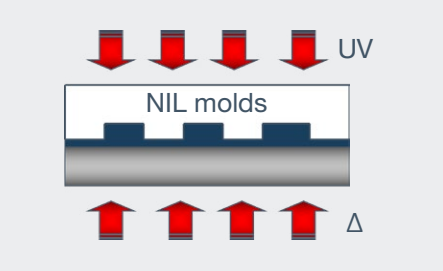
1. Spin coat



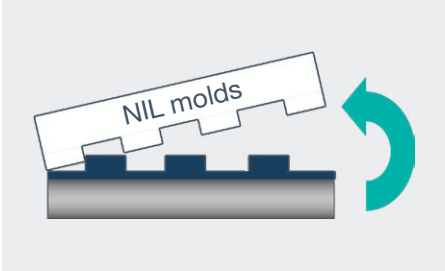
2. Imprint



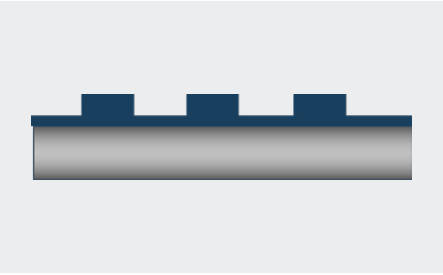
3. Cure (heat or UV)



4. Demoulding



5. Pattern replicated



Silicone-Based NIL Mold: s-PDMS

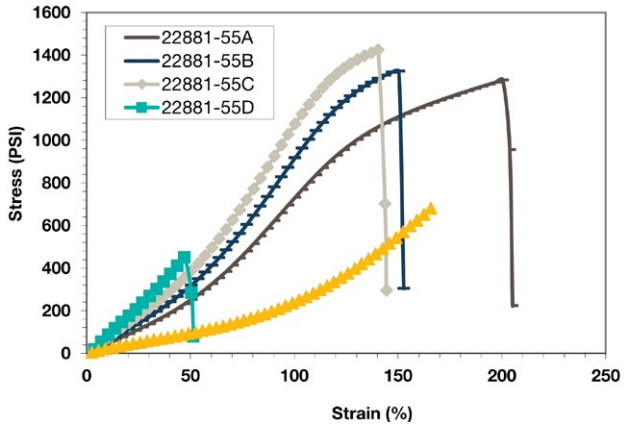
Soft-PDMS (s-PDMS)

- Sylgard 184: control
- High modulus SG184: 5, 10, 15 MPa
- Viscosity range: 1,000 to 5,000 cP
- Two-part solution (shelf-life: > 2 year at RT)
- One-part solution (shelf-life: > 6month/ 3-5°C)
- Low-temperature heat cure: 70 – 80°C

R&D	Mechanical properties after cure			
Sample #	Hardness	Young	Tensile	Elogat%
	(Shore A)	modulus (MPa)	(psi)	Average
SG184	50	1.8	1022	230
22881-55A	68	4.1	1307	206
22881-55B	71	5.1	1339	150
22881-55C	74	6.5	1376	138
22881-55D	78	7.6	426	47
23610-51B1	79	10.0	696	41
23610-51B2	82	12.0	435	16
23610-51B3	85	15.3	357	16

Example of flexible NIL mold structure

J. Nanosci. & Nanotech.
2013, 13, 3145

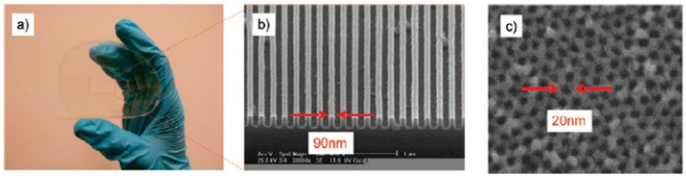


Silicone-Based NIL Mold: h-PDMS

UV-curable h-PDMS (hard-PDMS)

- Fluro-silicone composition for facile demolding
- High modulus (> 30MPa) / hardness (> 3H)
- Solvent-free composition
- Viscosity: 50-500 cP
- Fast UV-cure at RT (< 5 seconds)
- Uniform liquid film by spin-coating, or spray coating

UV-cure	Cured resin
UV-broadband at RT	Modulus*: 0.3-2.18 GPa
UV dosage: <0.5 J/cm^2	Hardness*: 0.05-0.15 GPa
Cure time: <3 second	Shrinkage < 3%
	UV transmittance > 90%



Fluor-silicone mold on PET made from SiO_2 master mold and patterned structures

Dow offering

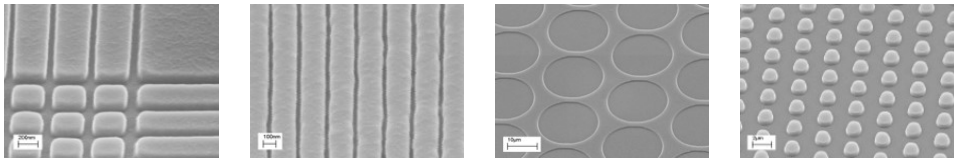
NIL mold material solutions

- S-PDMS
  - Low-T heat cure
- H-PDMS
  - UV-cure
- Other Silicone materials

Customized solution

UV-cure low-viscosity silicone for NIL

Enabling large patterning at low pressure



60 nanometer trenches

20 nanometer trenches

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Form No. 11-4326-01-0423 S2D