

Micro and Nano systems (Alain Bosseboeuf)

["smart" wafer-level packaging]

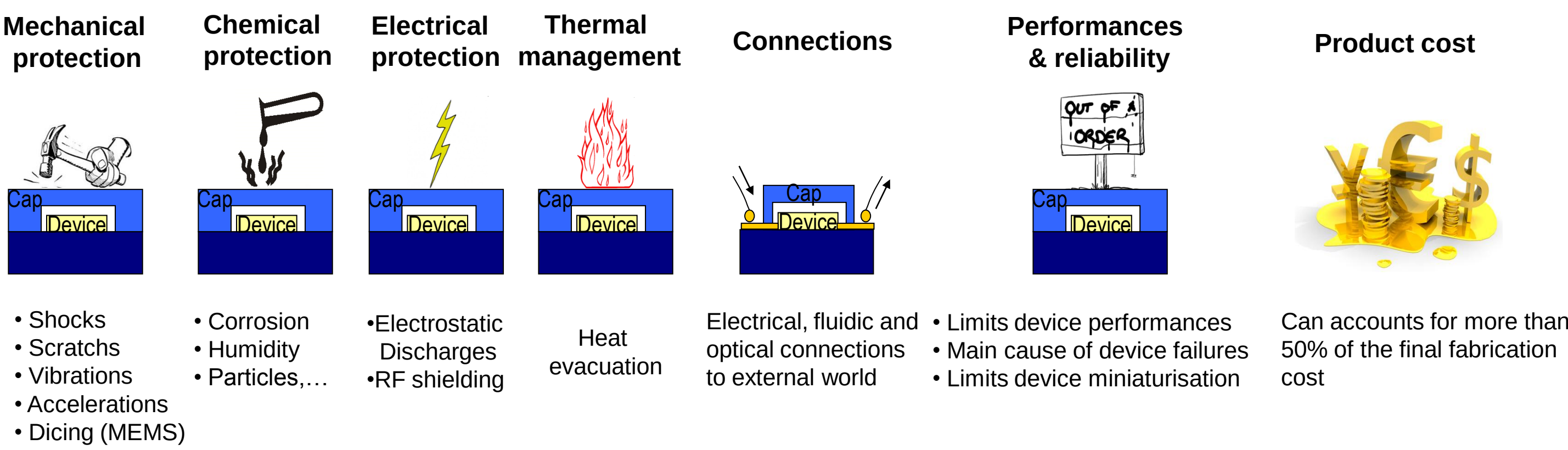
生産技術研究所 マイクロナノメカトロニクス国際研究センター
Centre for International Research on MicroNano Mechatronics
<http://www.cirmm.iis.u-tokyo.ac.jp>

Fundamental Microsystem Engineering

Objectives

Development of technological processes & characterization techniques for « smart » wafer-level packaging of micro/nano devices and systems

Importance of packaging of micro/nano devices & systems



« smart » wafer-level packaging

Addition of functions to the package useful for the device/systems

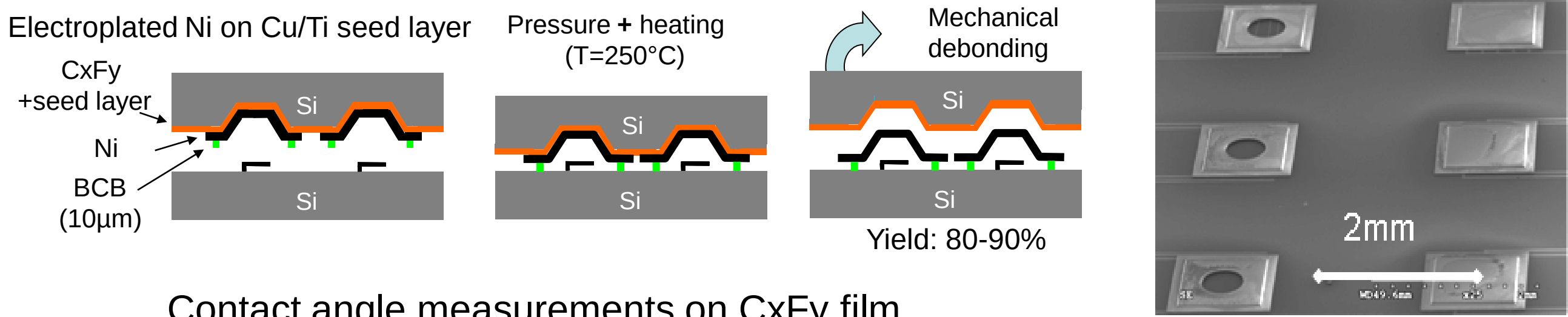
Device	Added functions
All	Internal package environment control
Resonant sensors, IR sensors	Vacuum maintenance and control
Micro Opro Electro Mechanical Systems	Optical functions : controlled reflectivity and absorbance, light beam shaping, filtering and polarisation control,etc
(electro)magnetic sensors and actuators	Magnetic circuit, magnetic shielding, µcoils
Bio and chemical sensors	Particle size filtering, gaz selectivity, fluidic functions, bio compatibility,etc

Wafer-level packaging processes & characterisation

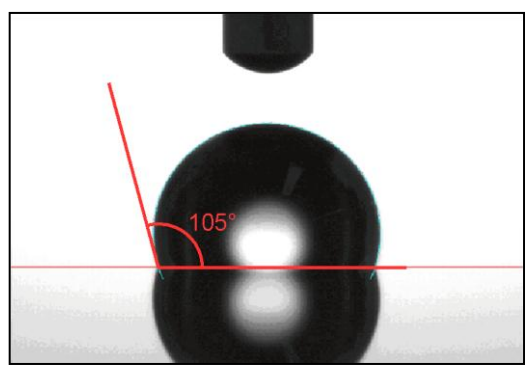
Multiple wafer packaging (vacuum or quasi hermetic)



Magnetic Single wafer « smart » packaging by 3D pattern transfer



Contact angle measurements on Cx/Fy film

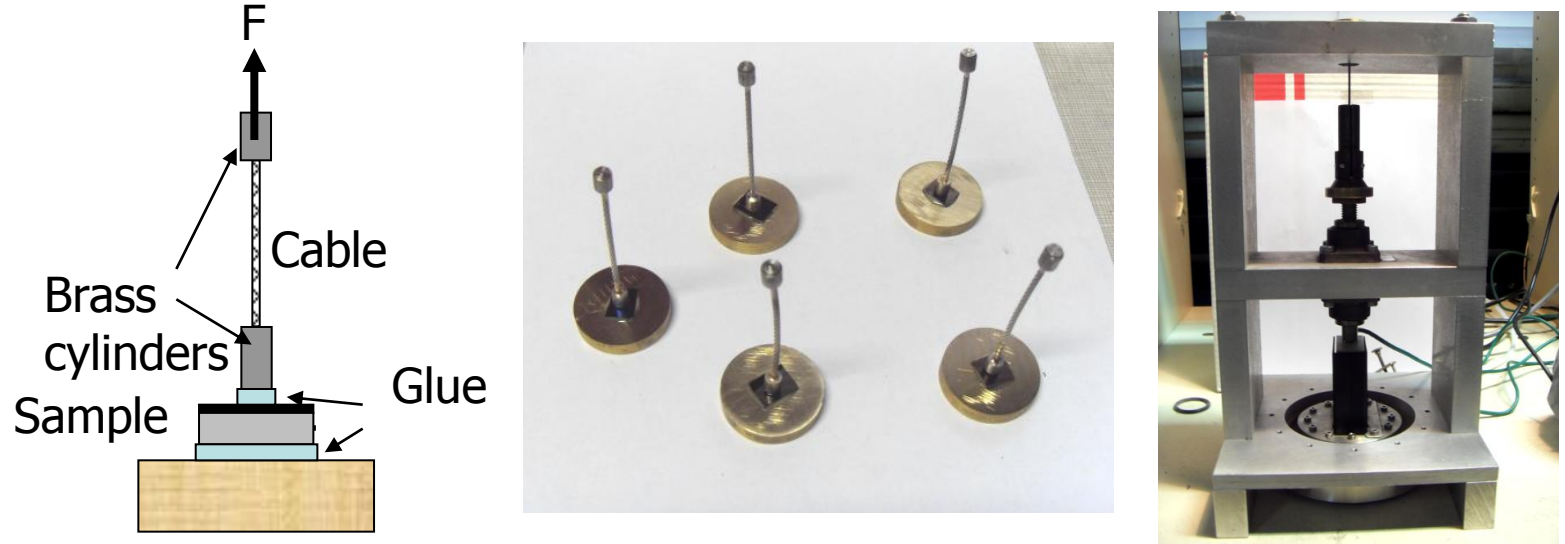


After deposition	116°
After N ₂ /H ₂ plasma	79°
After thermal annealing at 250°C	105°
After thermal annealing at 250°C and N ₂ /H ₂ Plasma	66°

Blister test

No failure up to 27 bars

Pull test of Si wafers bonded with ALD films (ALEBOND project, leader VTT)



TiO₂ or Al₂O₃ ALD films, 150-250°C

No debonding up to glue fracture limit (19-34 MPa)

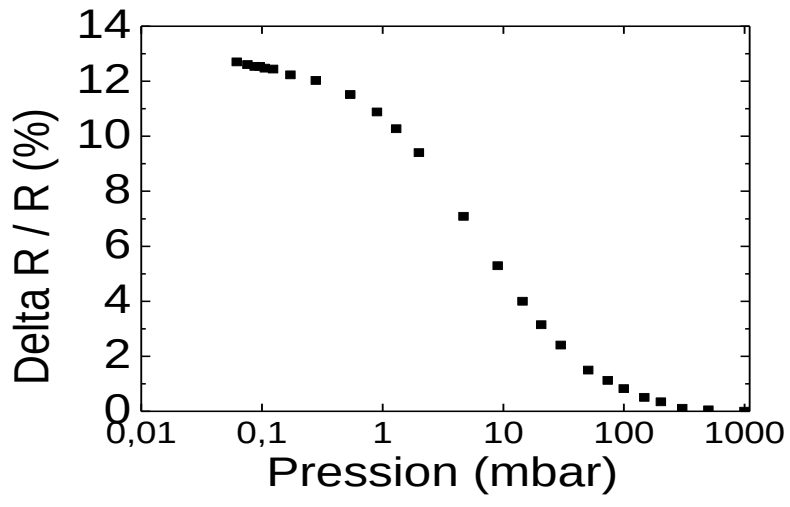
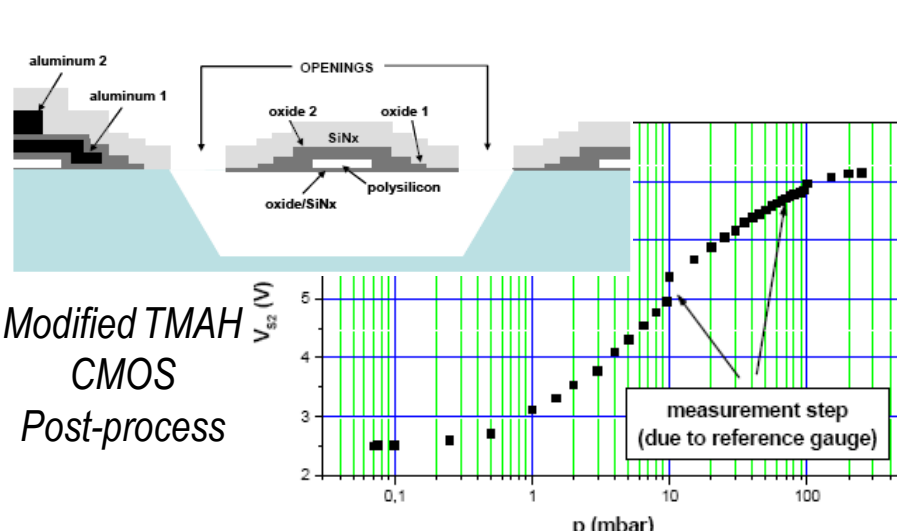
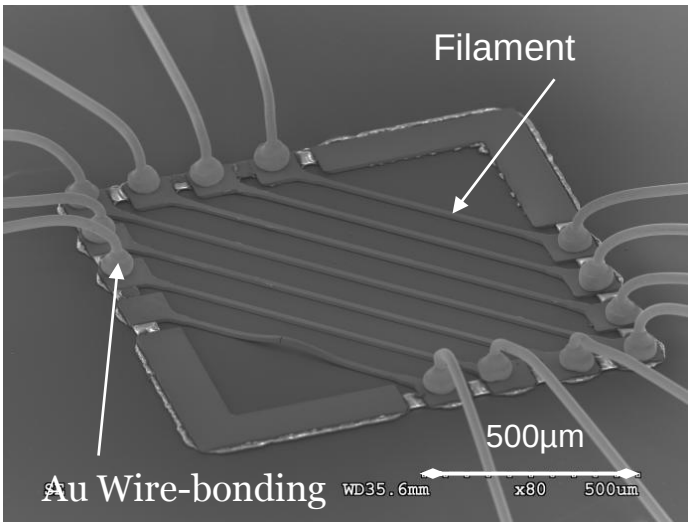
References

E. Lefeuvre et al., Procedia Chemistry 1(1) p.782, 2009
F. Mailly et al. Sensors and Actuators A 156(1) p.201 (2009)
O. Legendre et al., Proc. Micro Mechanics Europe Workshop, MME09, (2009)
E. Dufour-Gergam et al. Smart WLP, Patent (2009)
S. Brault et al. Microsystem Technologies, 4 (2010)
A. Bosseboeuf, Proc. Low Temperature wafer bonding for 3D Integration, p.145 (2010)
S. Lani et al., ECS Transactions, 16(8), p.147 (2008)

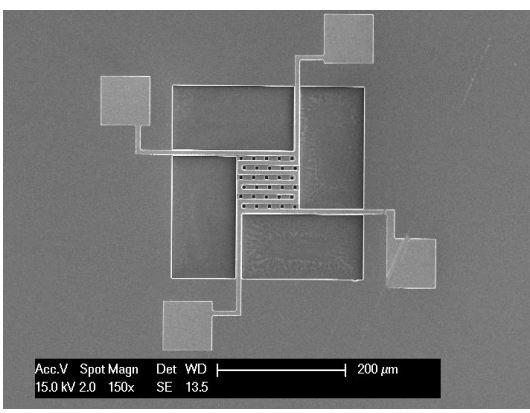
Sensors for « smart » packaging

Micro Pirani pressure gages

Transferred Ni micro Pirani gages CMOS micro Pirani (Coll. LIRMM)

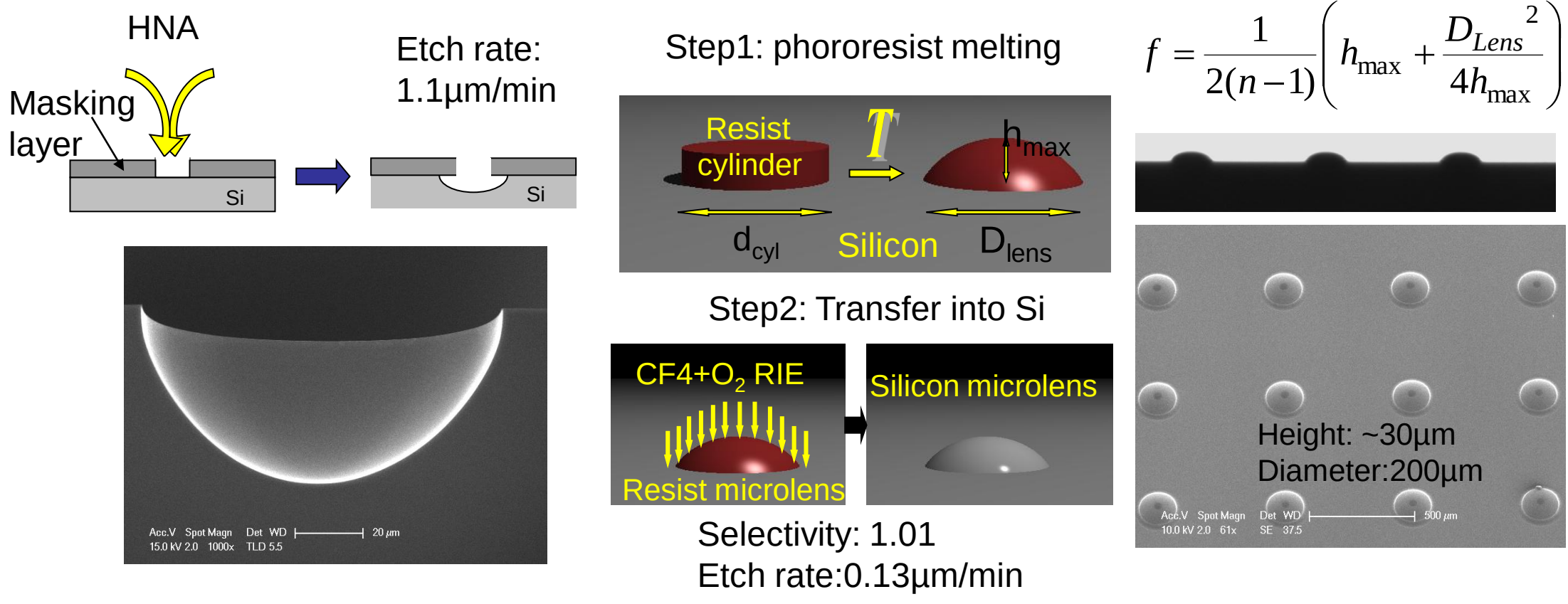


SOI high pressure microPirani gage



Microlenses for « smart » optical packaging

(Nguyen Phuoc Trung Hoa master training)



Parabolic multilevel aspheric polymer micro lens

