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TOWARDS LOW-COST LOCALISED HETEROEPITAXIAL GROWTH GAAS ON SILICON

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TOWARDS LOW-COST LOCALISED HETEROEPITAXIAL GROWTH GAAS ON SILICON

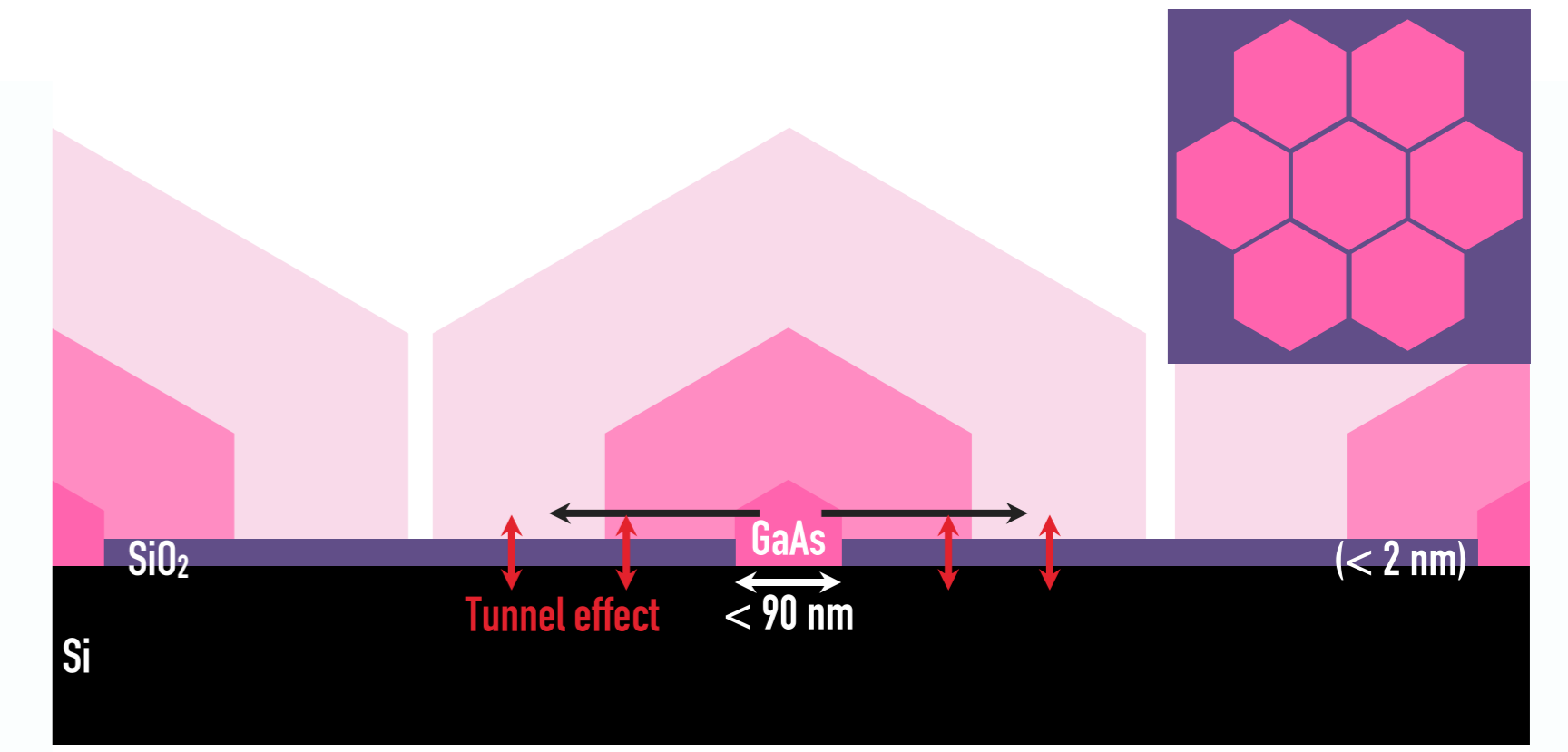
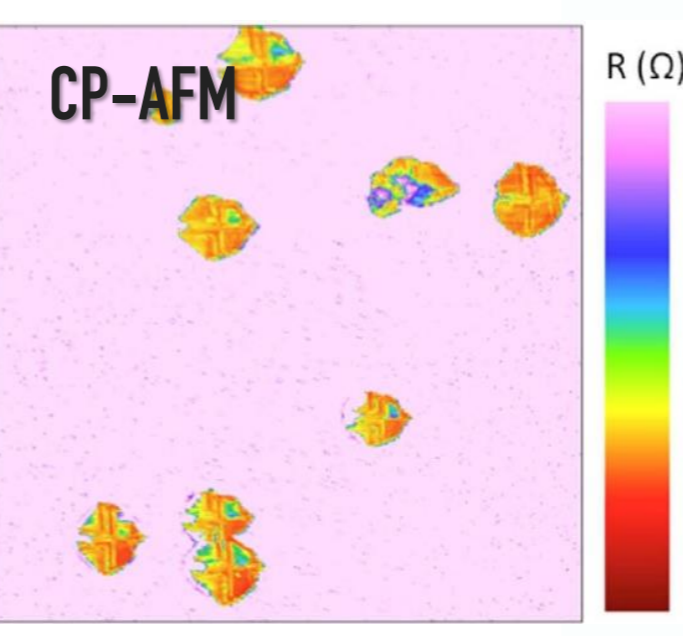
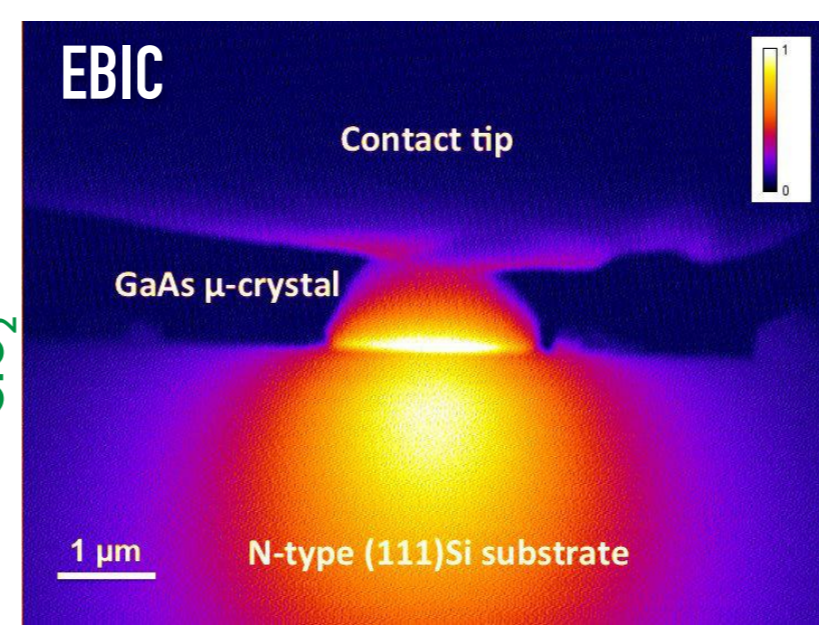
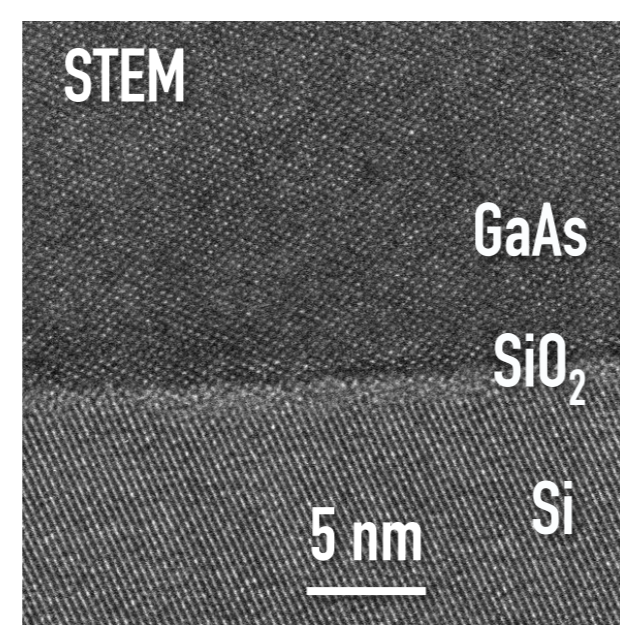
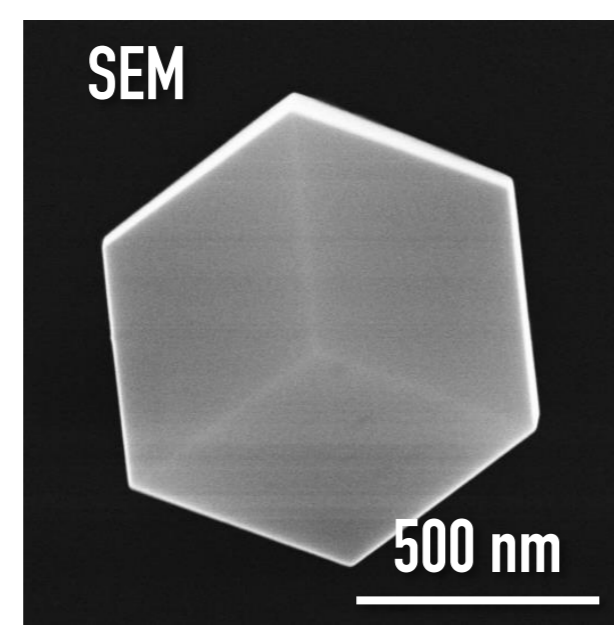
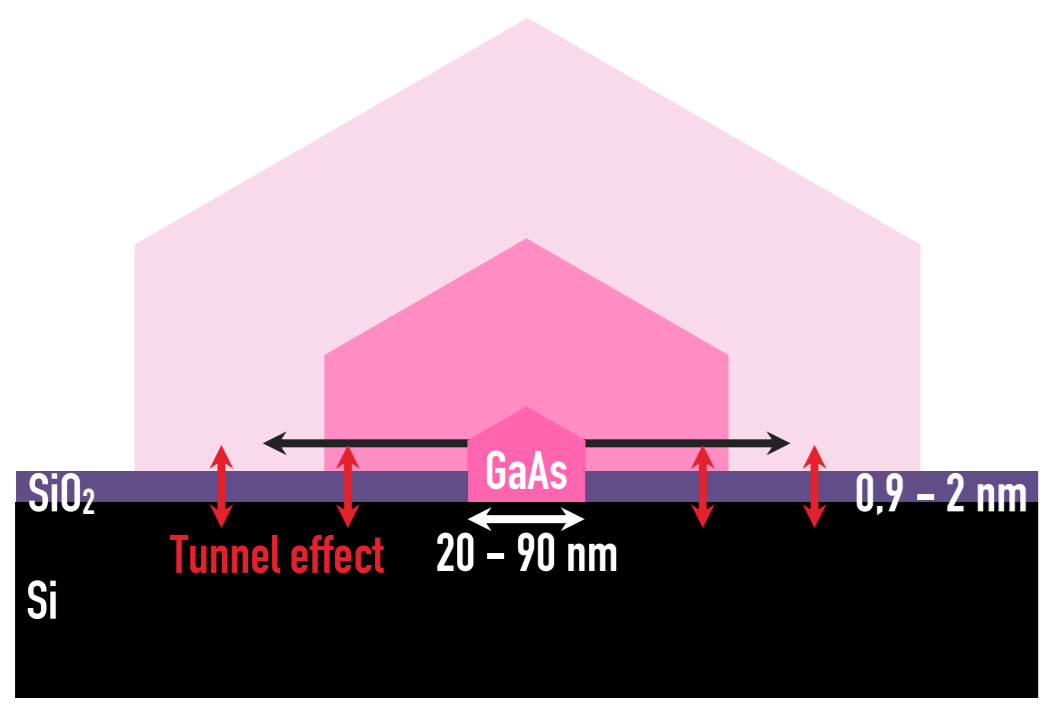
L. Dentz¹, F. Hamouda¹, G. Hallais¹, T. Baptiste¹, L. Leroy¹, E. Herth¹, L. Ferlazzo¹, D. Bouchier¹, L. Largeau¹, L. Vincent¹, C. Renard¹.

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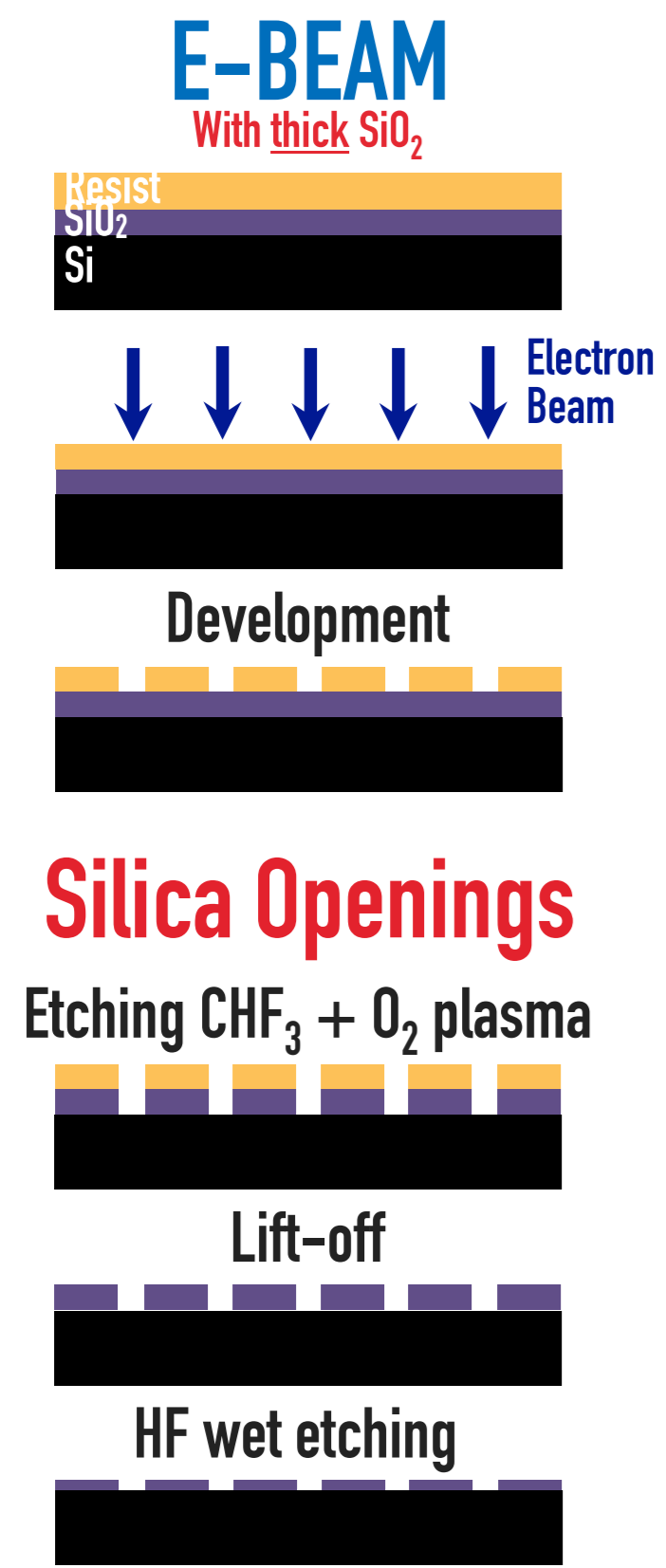
*laurie.dentz@cnrs.fr

ELTON GROWTH METHOD: Epitaxial Lateral overgrowth on Tunnel Oxide from nano-seed

Localised heteroepitaxial growth



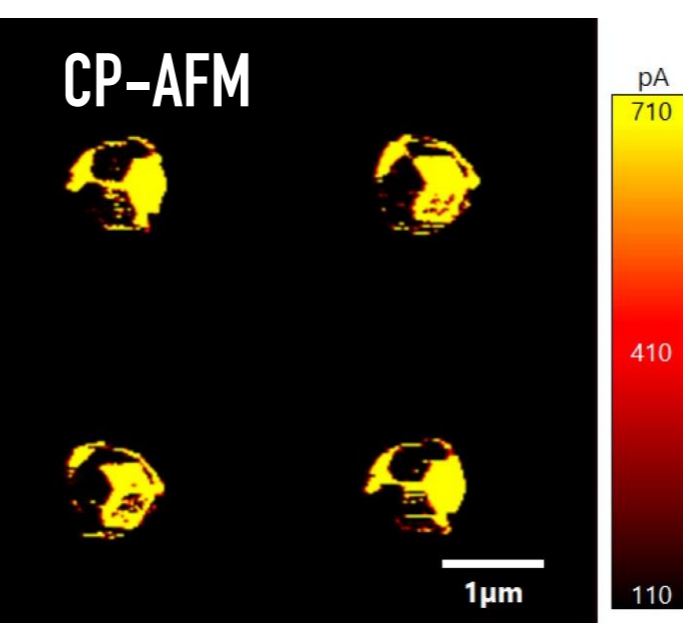
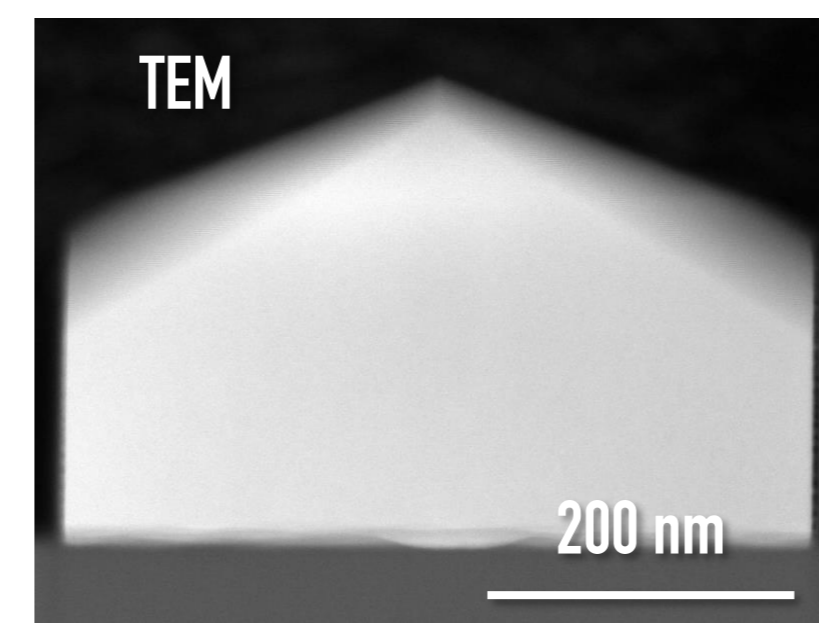
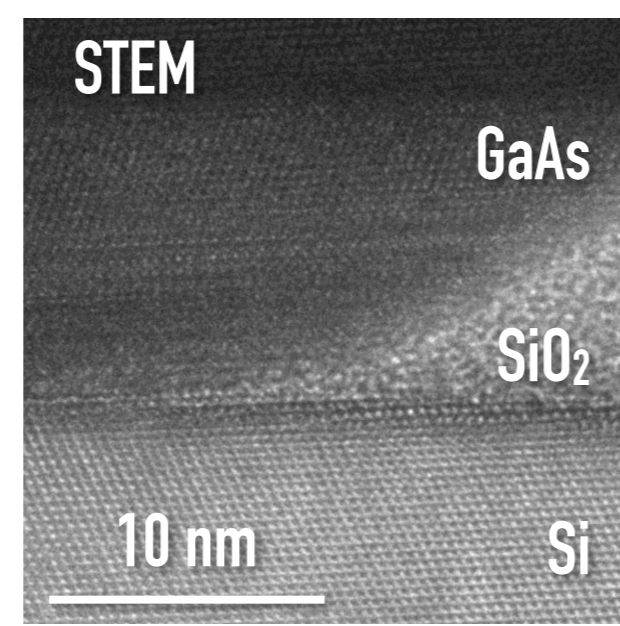
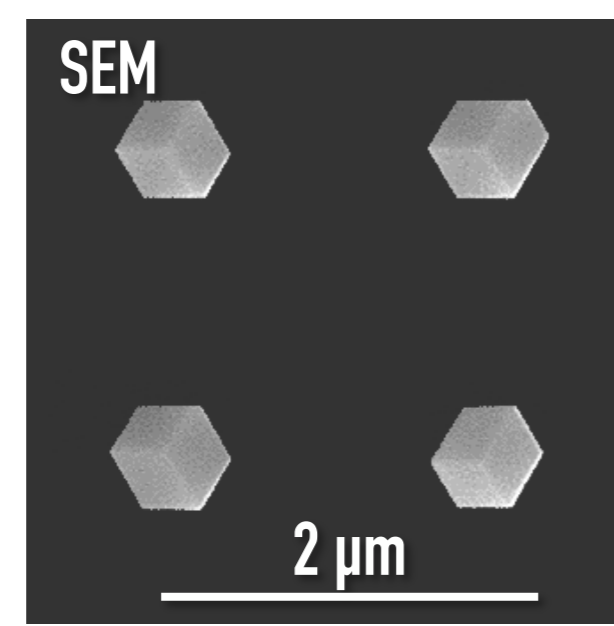
Conventional Lithography



Ultra-thin SiO₂ ~ 1.2 nm
Current passing through the entire crystal

Thick SiO₂ ~ 10 nm
Current passing only through the opening

Direct bias
200 times lower



CHALLENGES

Lower Lithography Cost

Alternative Lithography

Openings in a ultra-thin SiO₂ Layer

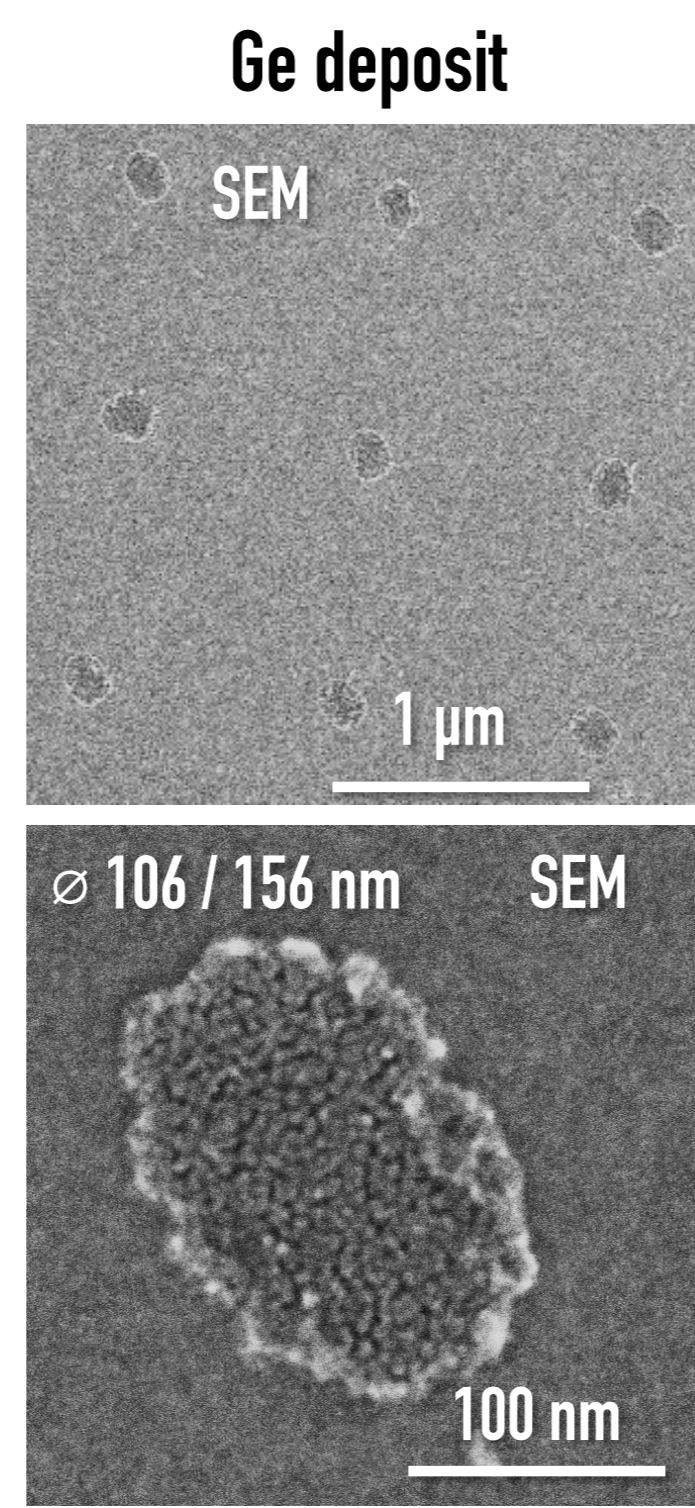
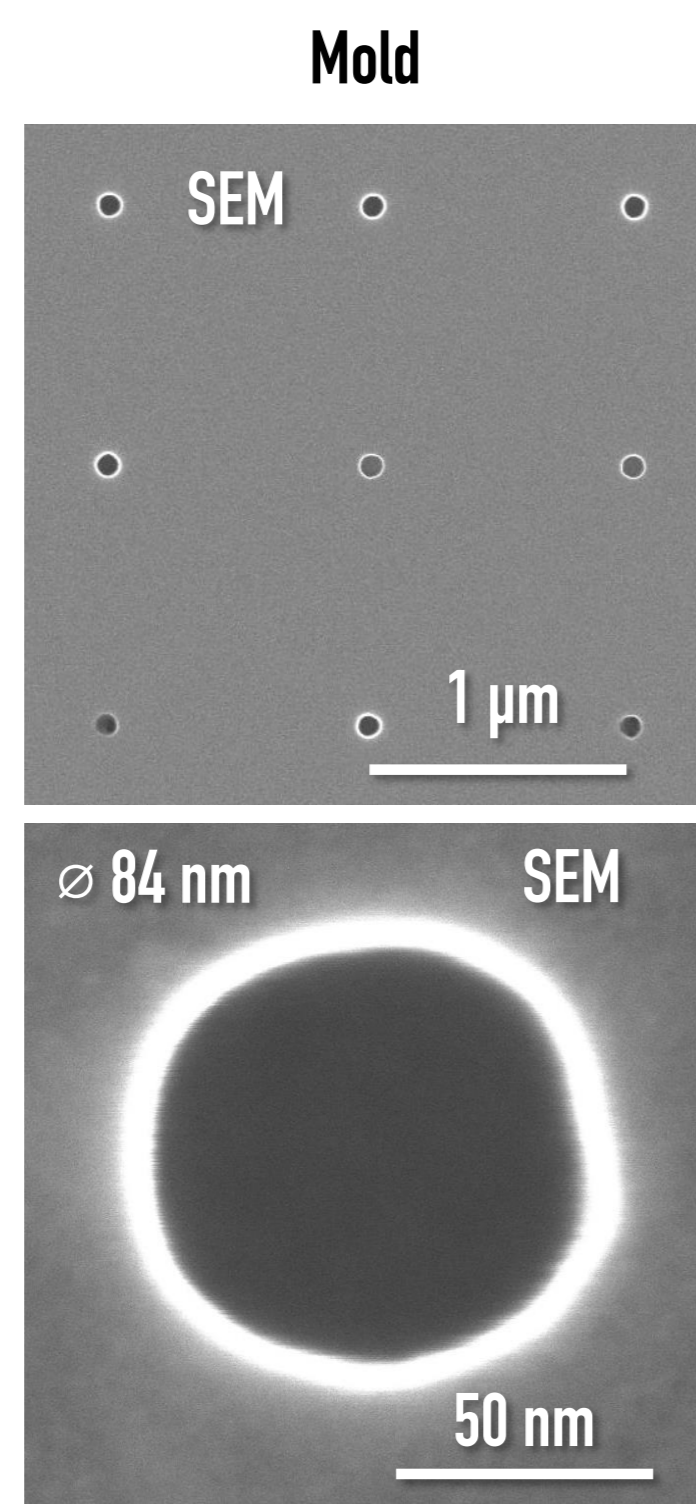
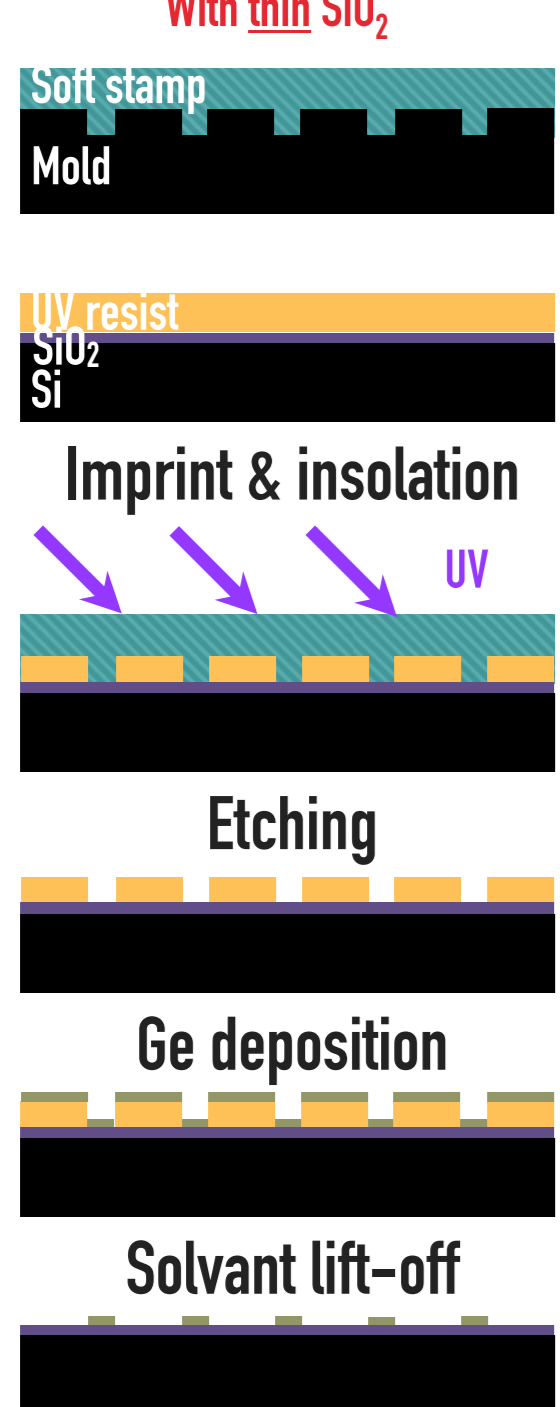
Relaxed and non-deficient GaAs crystal:
< ø 90 nm SiO₂ openings

Tunnel-effect conductive interface:
< 2 nm thick SiO₂ layer

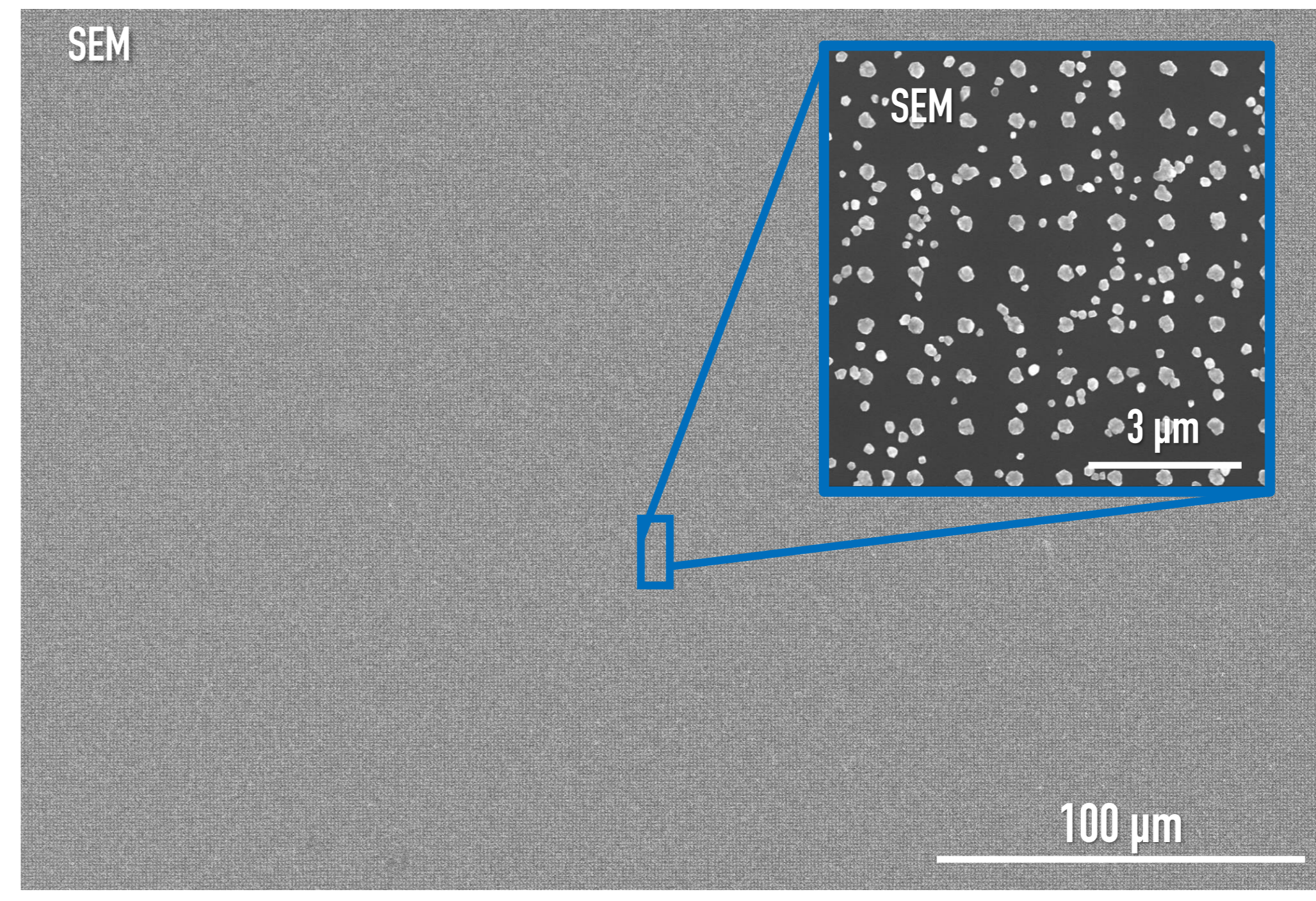
CONTEXT & OBJECTIVES

ALTERNATIVE LITHOGRAPHY PROCESSES

SOFT-UV NIL



Growth after 1H15 annealing at 675°C



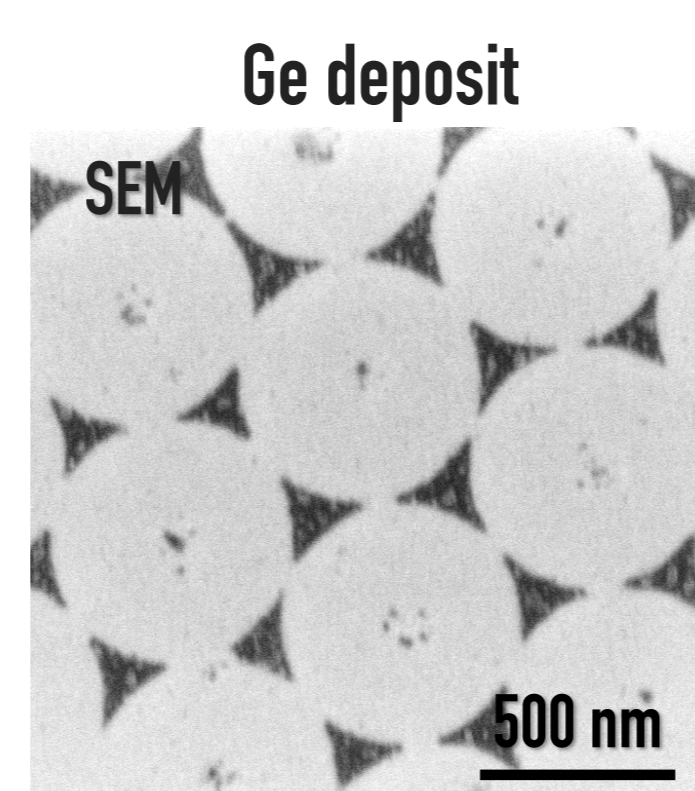
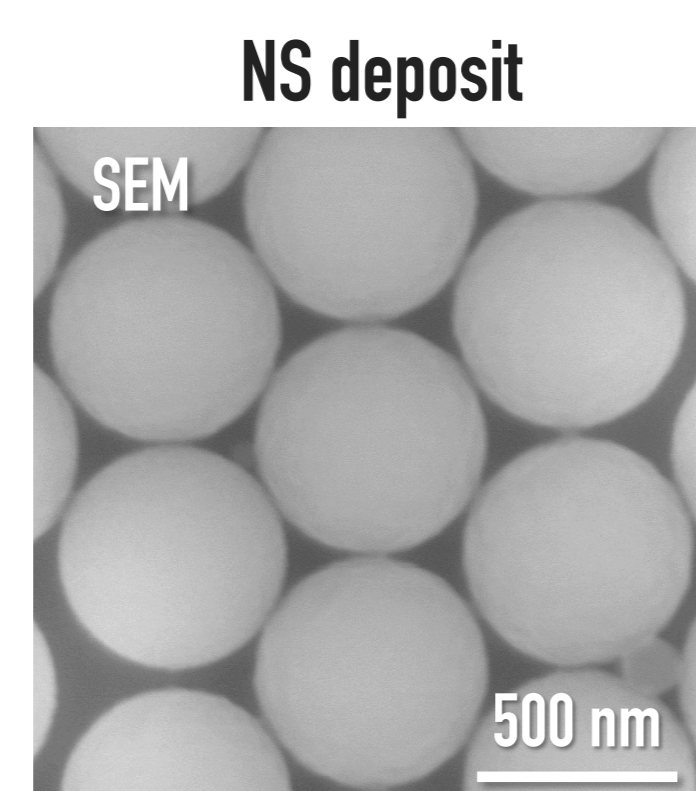
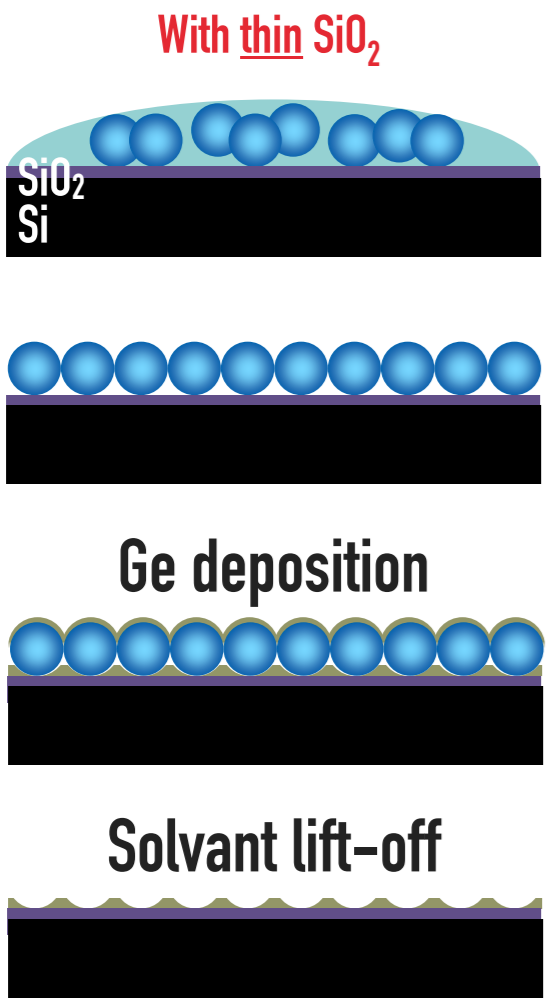
Soft-UV NIL & Nanosphere Lithographies

Growth mostly occurs in the imprint
Localised

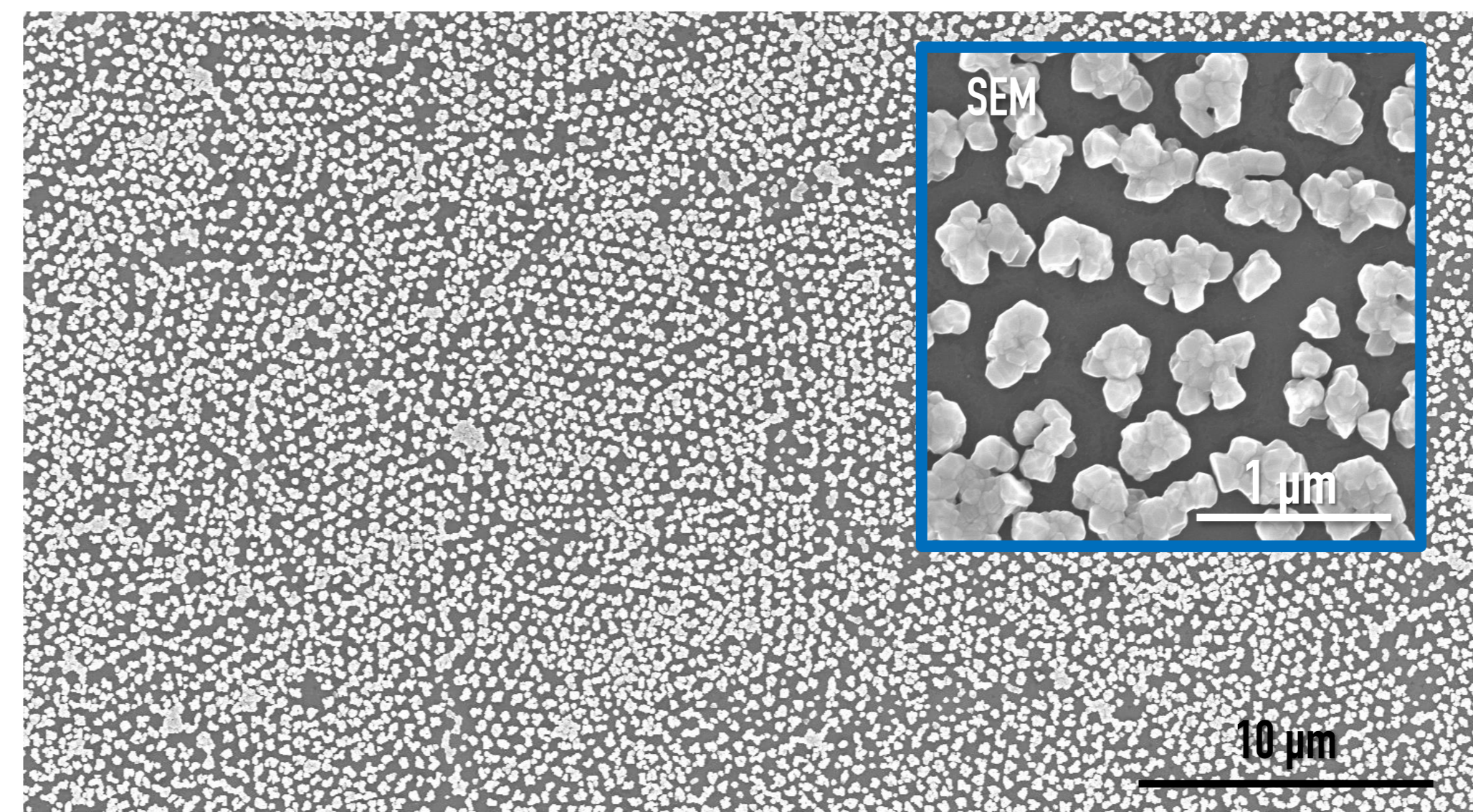
Some growth occurs outside the imprint
Random thermal openings in SiO₂

Polycrystalline
Residual germanium

NANOSPHERE

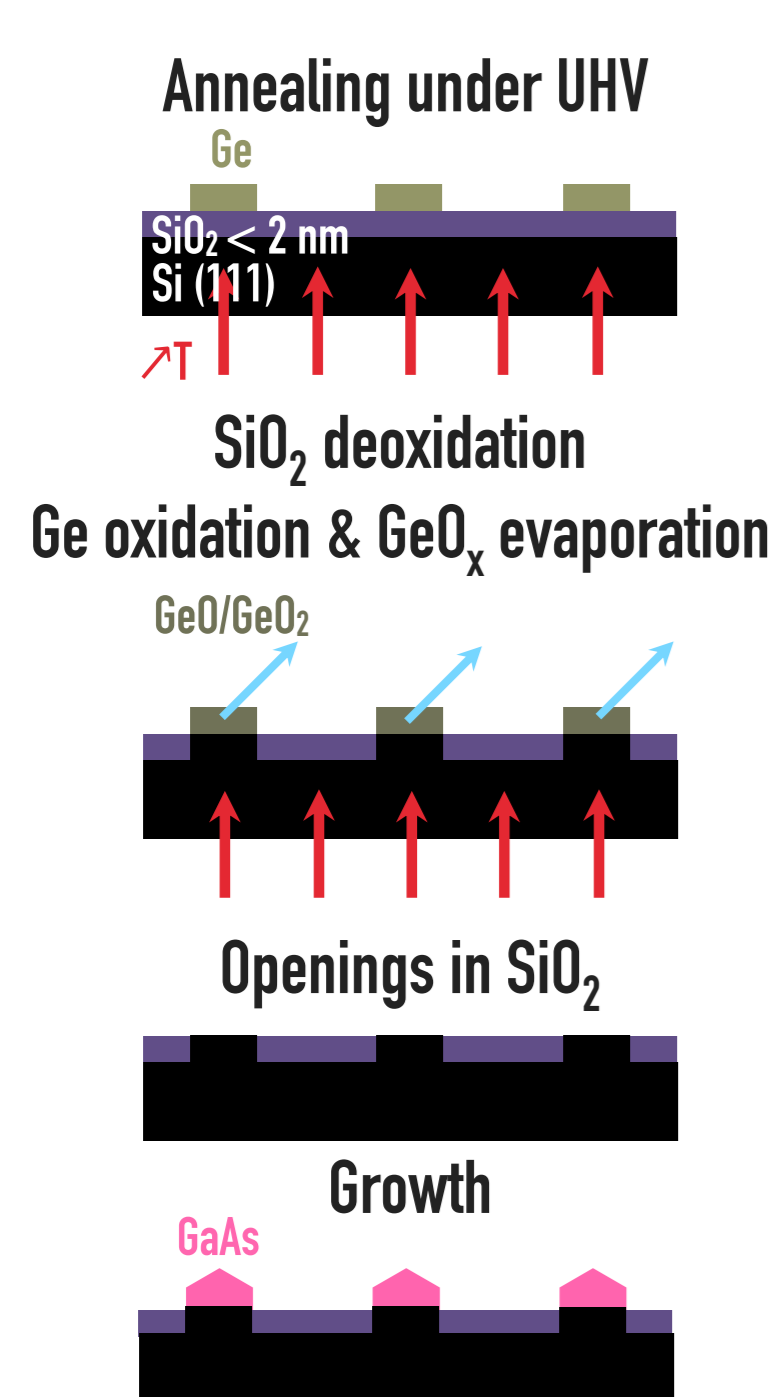


Growth after 1h at 700°C

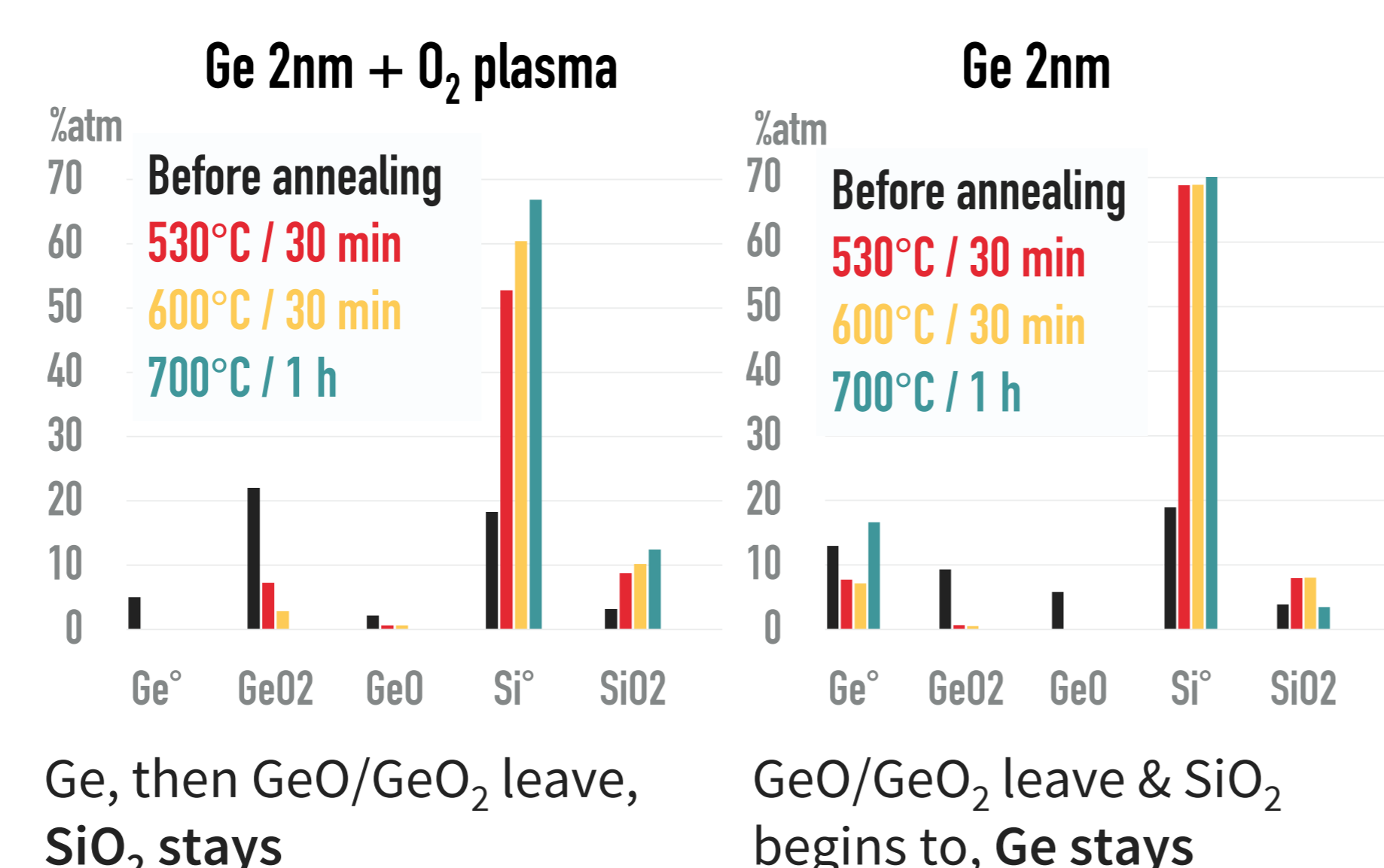


Nanosphere self-assembly into a compact hexagonal lattice

Assumption GERMANIUM DESORPTION



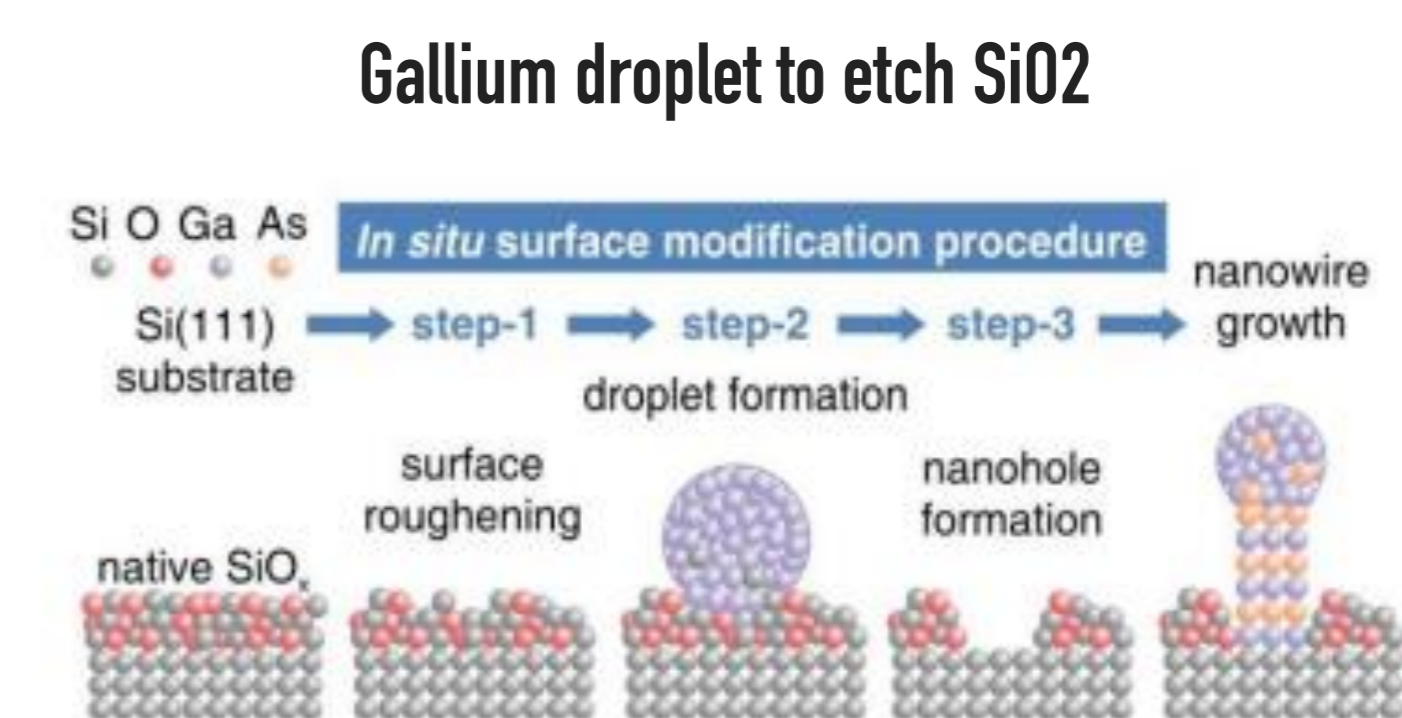
XPS study



This assumption has been demonstrated to be false
Germanium cannot open the SiO₂ layer

Both Soft-UV NIL & Nanosphere Lithographies Promising candidates for low-cost localisation of growth

Opening in an ultra-thin SiO₂ Layer
Other perspectives in progress



Decoupling the two roles of Ga droplets in the self catalyzed growth of GaAs nanowires on SiO_x/Si substrates
Tauchnitz T, Nurmamyrtov T, Hübner R, Engler M, Facsko S, Schneider H, et al. Cryst Growth Des. 4 oct 2017;17(10):5276-82.

PERSPECTIVES

SILICA OPENINGS