INSCOOP: Intégration de Nanofils III-V sur SOI pour COnnections Optiques sur Puce

ANR-P2N 2011

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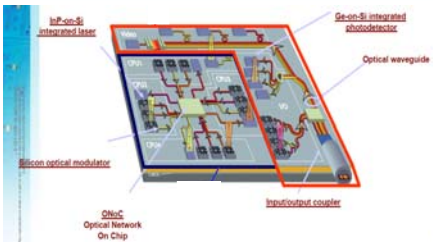
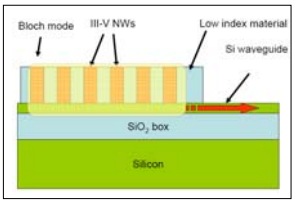
Contexte: la Photonique Silicium

- Interconnexions optiques sur puces
- Intégration monolithique d'une microsource optique sur Si par la « technologie nanofils »
- Couplage de la microsource à base de NFs avec un guide d'onde Si sur SOI

→ **vers des « nanofils photoniques »**



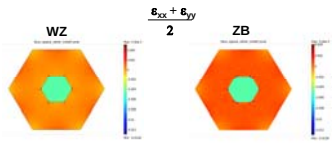


Microsource optique à base de NFs formant aussi une cavité résonante de type PhC dont le mode optique va se coupler avec celui d'un guide d'onde Si sur SOI

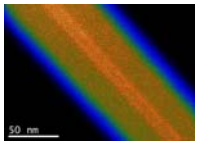
LPN

Core-shell NWs, NWs on Si(111)
Structural and optical properties
Strain and Growth modeling

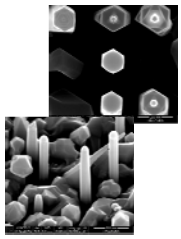
Strain relaxation

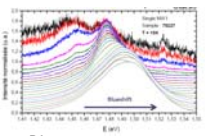


Core-shell InAsP/InP NWs on InP



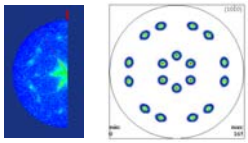
InP NWs in holes in SiO2/Si(111)





PL spectroscopy on single InP NW

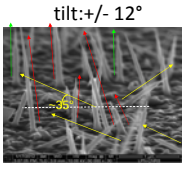
XRD pole figure for NWs growth directions



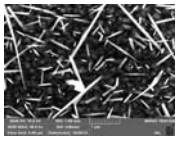
INL

Vertical NWs on Si(001), STO/Si(001)
Au-free catalyst
Structural and optical properties of NWs
Microsource and coupling modeling (with CEA)

80% of vertical InP NWs on STO(001): tilt:+/- 12°



InP NWs with In droplet catalyst



On Si(111) + BOE

On Si(111) + natural oxide

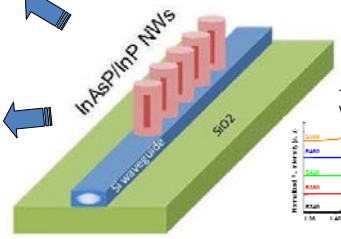
Foton

Exciton modeling

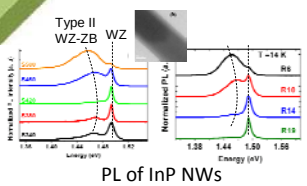
-DFT atomistic modeling
Deformation potential
Band-offsets

ZB offset (111)	V_LDA (eV) [massif]	V_LDA (eV) [super-réseau]	Ev (eV)	VBO (eV)
InAs	-9.24	- 8.82	0.06	0.39
InP	-9.48	-10.05	0.65	

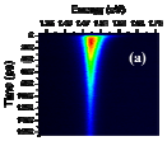
WZ offset	V_LDA (eV) [massif]	V_LDA (eV) [super-réseau]	Ev (eV)	VBO (eV)
InAs	-9.23	- 8.72	0.08	0.31
InP	-9.46	- 9.88	0.69	

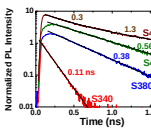


Type II WZ-ZB



PL of InP NWs (function of Tc and V/III ratio)

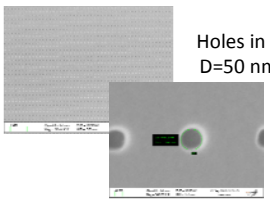




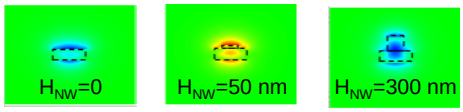
Exciton life time of InP NWs by TRPL

LTM

Site-controlled catalyst on SOI waveguide
Au-free catalyst



Holes in SiO2/Si(111) D=50 nm, p=200 nm



Resonator and coupling modeling: 3D FDTD

Useful E.M. Field is mainly located in the foot of the NW

CEA-Leti-Dopt

SOI waveguide
NWs integration

Production scientifique (publications, brevets)

J. Even, L. Pedesseau, C. Hajlaoui, C. Katan and J-M. Jancu, Non-linear electro-elastic coupling in non-centrosymmetric materials, Journal of Physics: Conference Series, 2012.
J. Even, L. Pedesseau, C. Hajlaoui, C. Katan and J-M. Jancu, Theory, modelling and computational methods for semiconductors, (TMCS III), Jan 18, 2012 – Jan 20, 2012, Leeds, United Kingdom.
JC. Harmand, F. Jabeen*, L. Liu, G. Patriarche, K. Gauthron, P. Senellart, D. Elvira, A. Beveratos, InP1-xAsx quantum dots in InP nanowires: a route for single photon emitters , The 17th International Conference on MBE (ICMBE 2012), September 23-28, 2012, Nara, Japan,To be published in J. Cryst. Growth
K. Naji , H. Dumont, G. Saint-Girons, J. Penuelas, G. Patriarche, M. Hocevar, V.Zwiller, M. Gendry, Growth of vertical and defect free InP nanowires on SrTiO3(001) substrate and comparison with growth on silicon, Journal of Crystal Growth, 101-104 343 (2012)
H. Khmissi, K. Naji, M.H. Hadj Alouane, N. Chauvin, C. Bru-Chevallier, B. Ilahi, G. Patriarche, M. Gendry, InAs/InP nanowires grown by catalyst assisted molecular beam epitaxy on silicon substrates, Journal of Crystal Growth 45-50 344 (2012)
N. Chauvin, M.H. Hadj Alouane, R. Anufrief, H. Khmissi, K. Naji, G. Patriarche, C. Bru-Chevallier, M. Gendry, Growth temperature dependence of exciton lifetime in wurtzite InP nanowires grown on silicon substrates, Applied Physics Letters 011906 100 (2012)
R. Anufriev, M. H. Hadj Alouane, N. Chauvin, H. Khmissi, K. Naji, A. Belarouci, B. Ilahi, H. Maaref, G. Patriarche, M. Gendry and C. Bru-Chevallier, InAs/InP nanowire quantum rodsemitting in the 1.55 μm telecommunication window on silicon substrate, 6th NGW, 4-6 June, 2012, Saint-Petersbourg, Russia

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