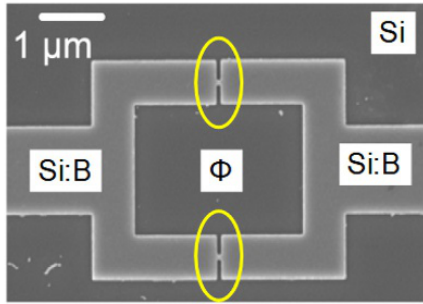


Semiconductor processing for (quantum) information, photonics and energy

Speaker(s):

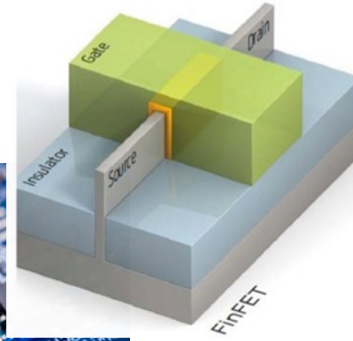
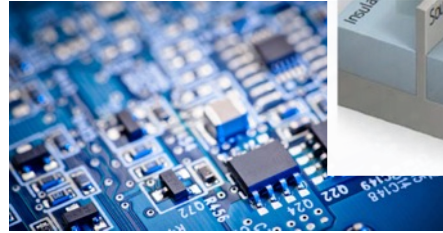
prof. Enrico Napolitani
Dipartimento di Fisica e Astronomia

Applications

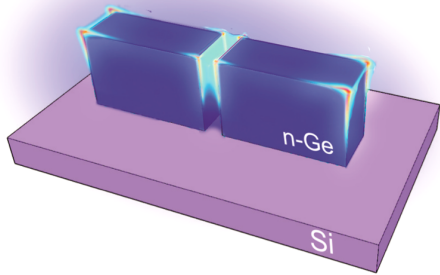
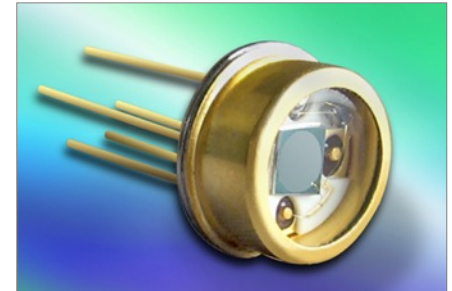


Quantum bits

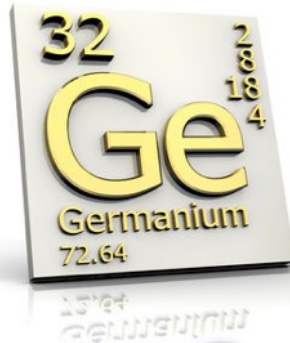
Nanoelectronics



Photodetectors

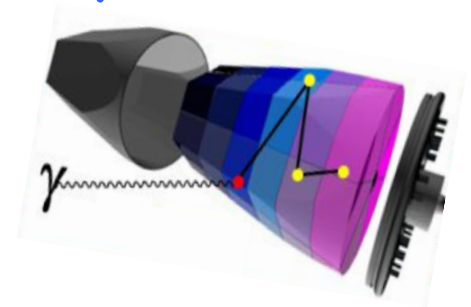


Plasmonic molecular sensors

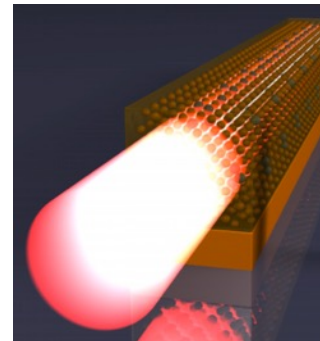


but also Si, GaN, SiC, MoS₂, ...

γ -Ray detectors

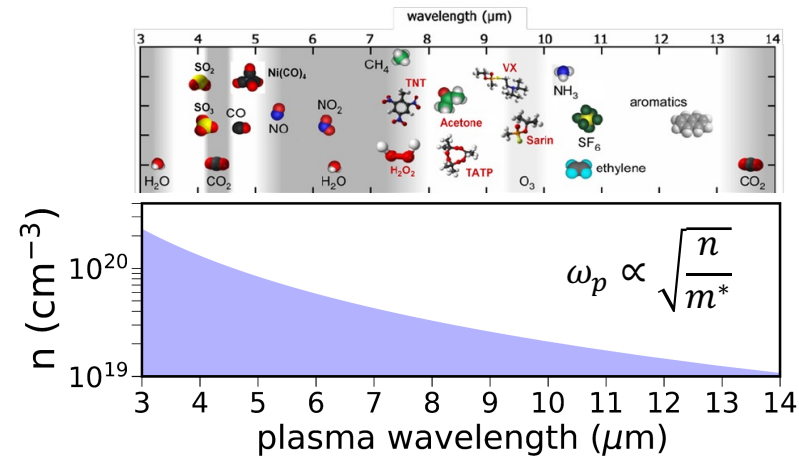
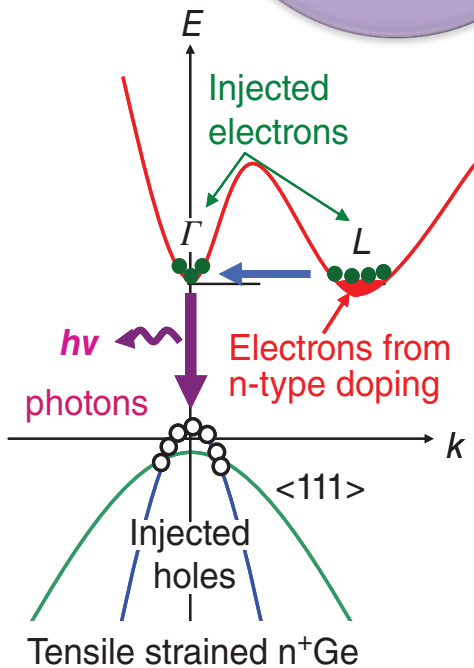
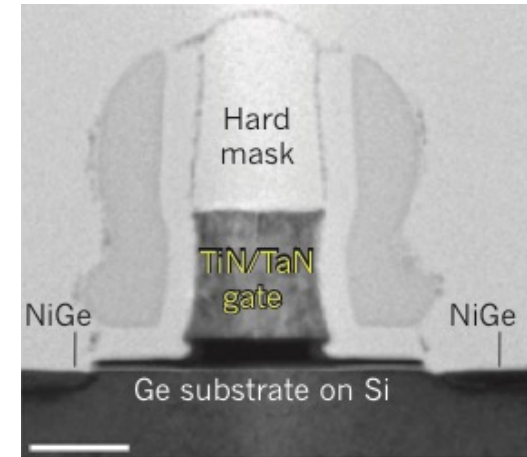
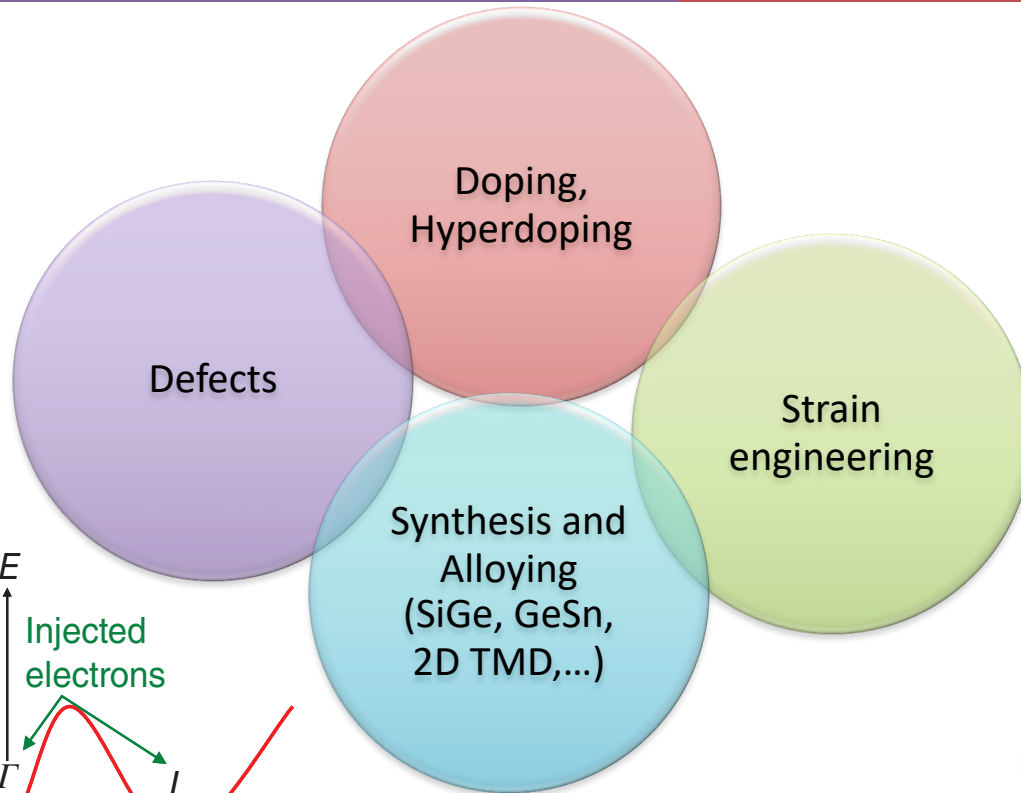


Solar cells



Lasers

Semiconductor processing



UV Pulsed Laser Processing



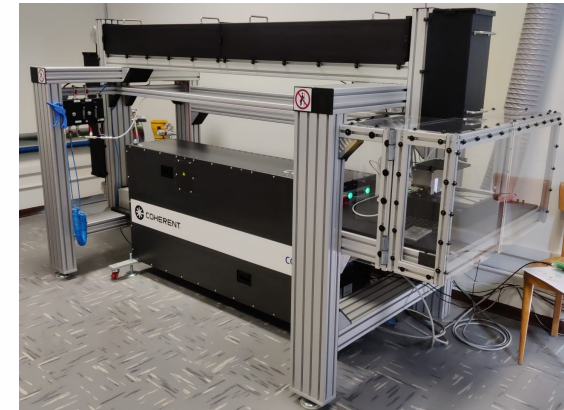
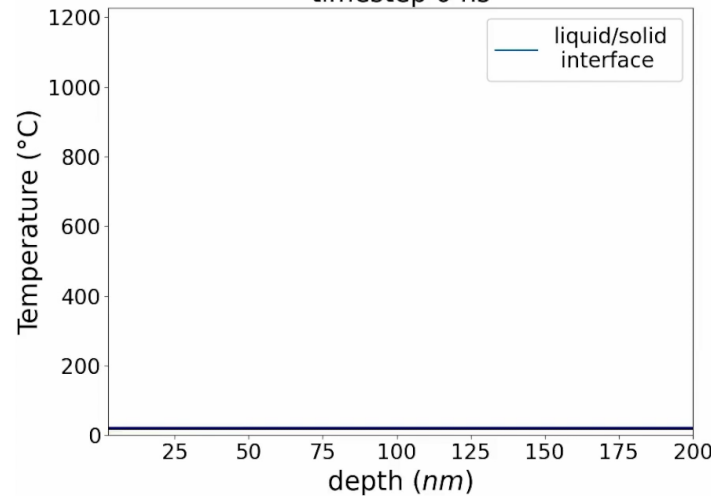
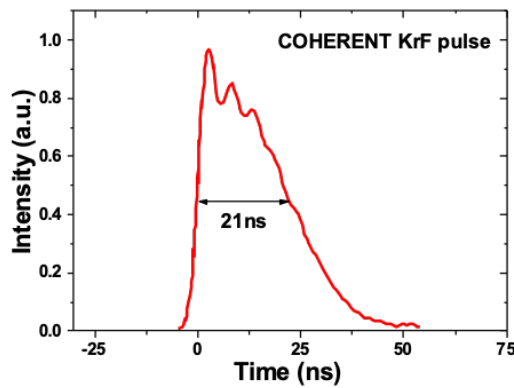
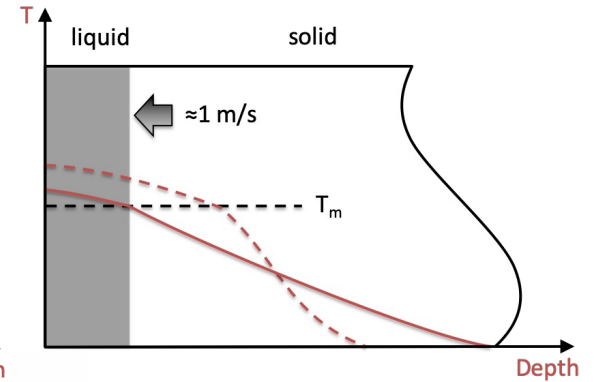
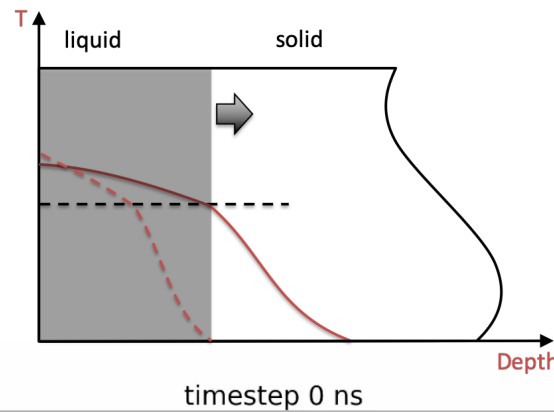
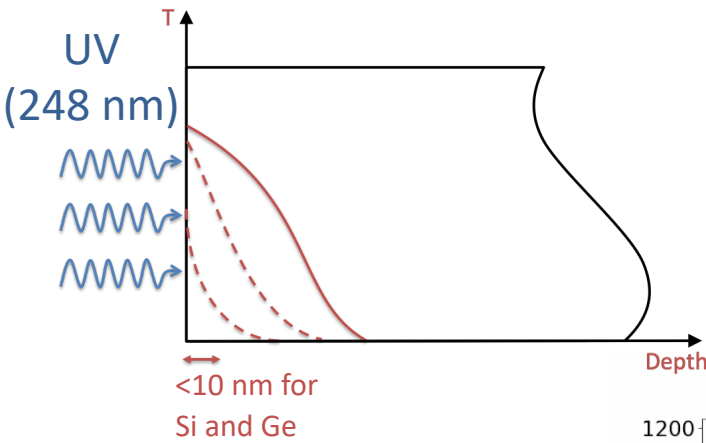
Heat Diffusion

$$\frac{\delta T}{\delta t} = D \nabla^2 T + \frac{A}{\rho C}$$

Melting

Epitaxial regrowth with velocity:

$$v_r = \frac{k}{\Delta H \rho} \frac{\delta T}{\delta z}$$

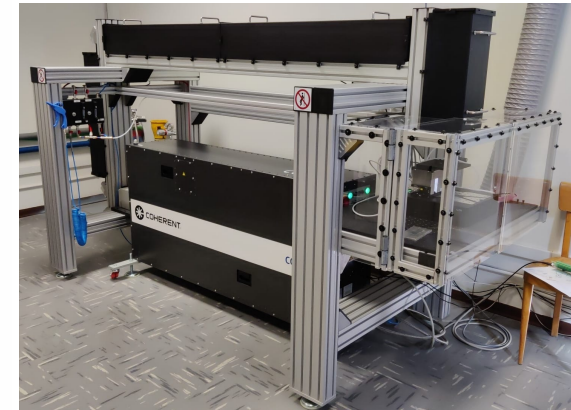
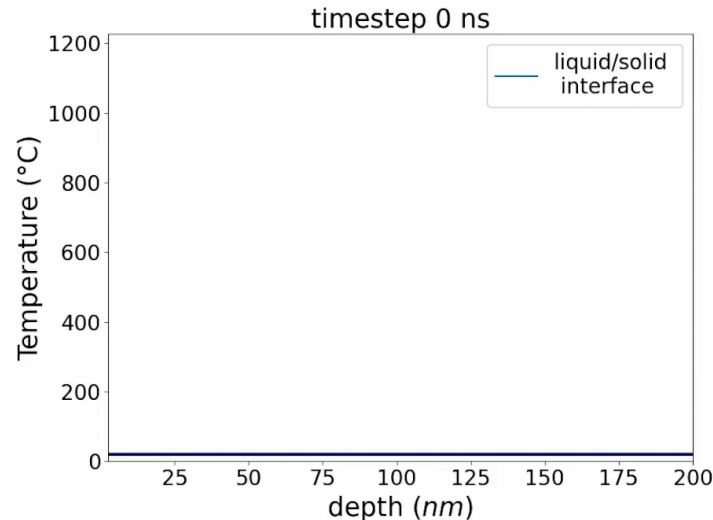
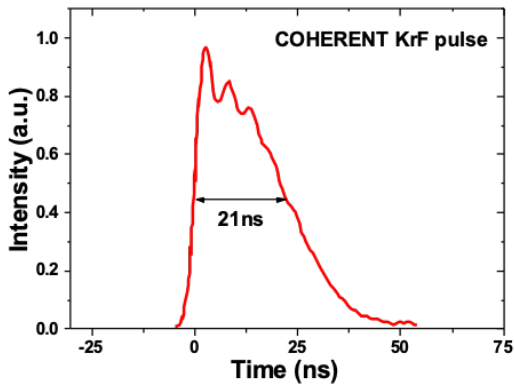


Laser Processing Lab @DFA

Laser Processing

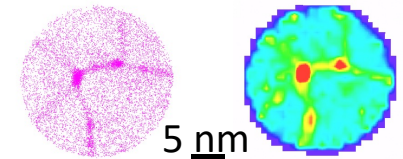
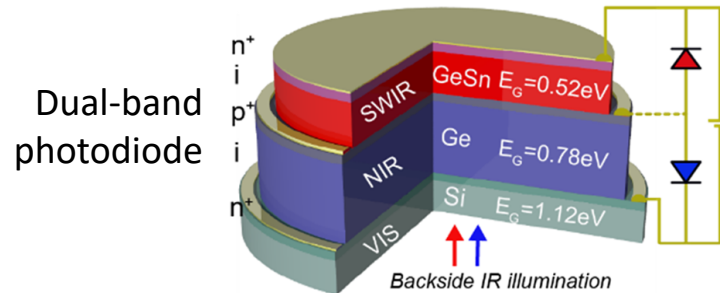
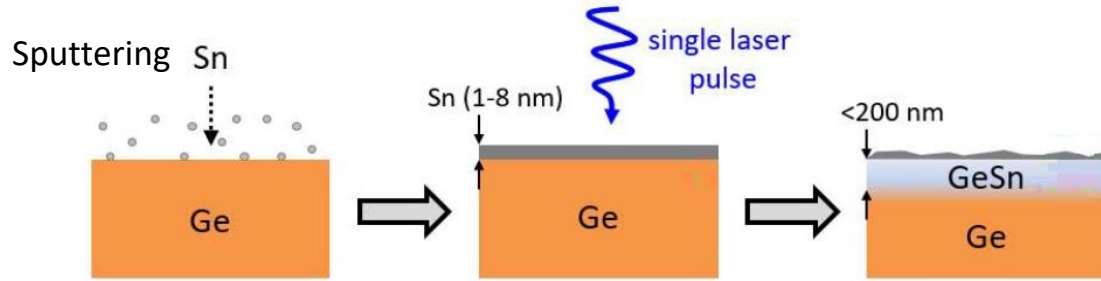
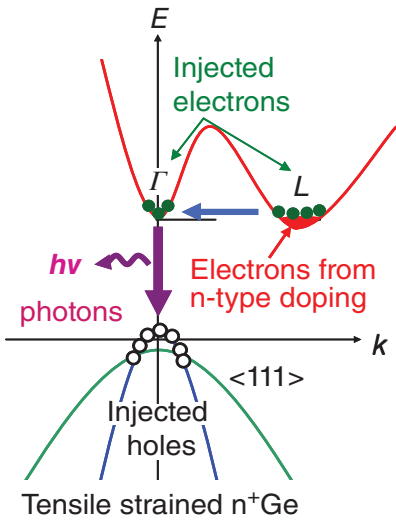


- Temporal confinement (<100 ns):
 - Extremely fast processes
 - Synthesis of new materials
 - Alloying, hyperdoping above equilibrium solid solubility
- Vertical confinement (<100 nm):
 - Depth control of doping
 - Selective heating of layers on 'delicate' substrates
- Lateral confinement

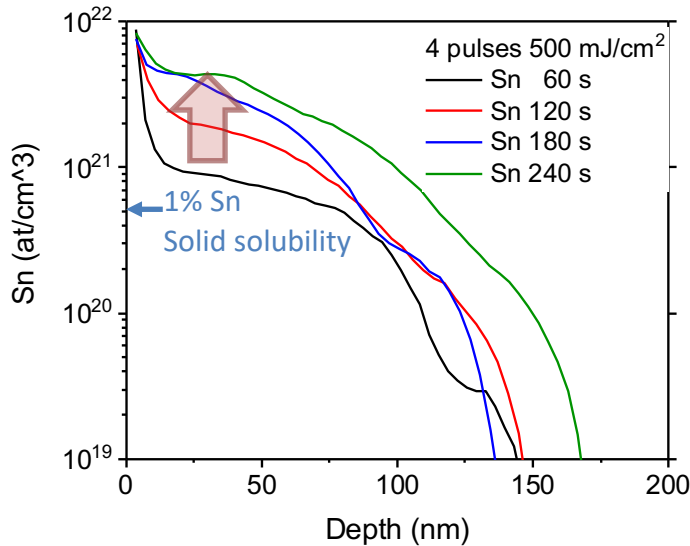


Laser Processing Lab @DFA

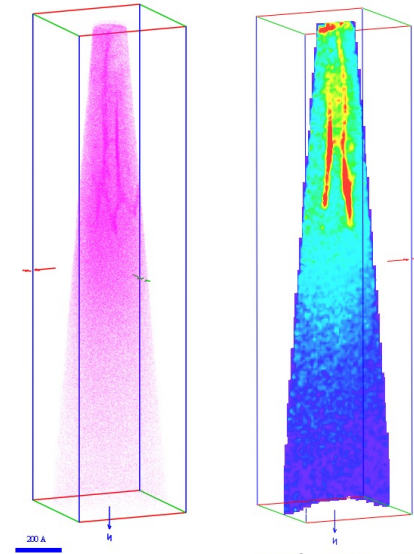
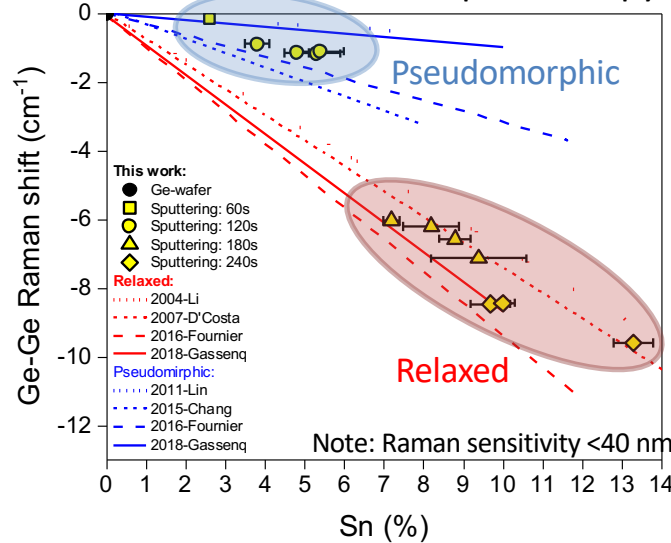
RETINA: GeSn alloying (MIUR Prin project)



Secondary Ion Mass Spectrometry



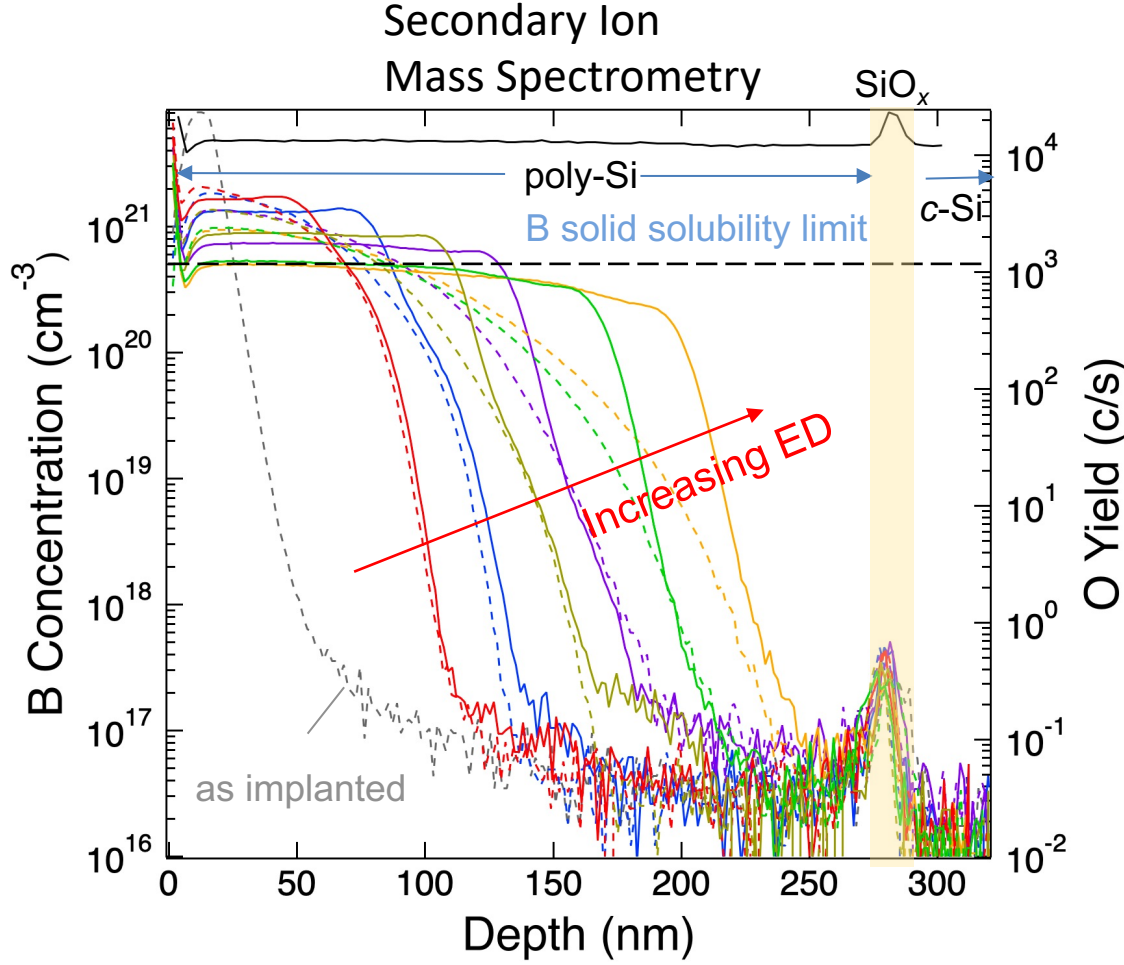
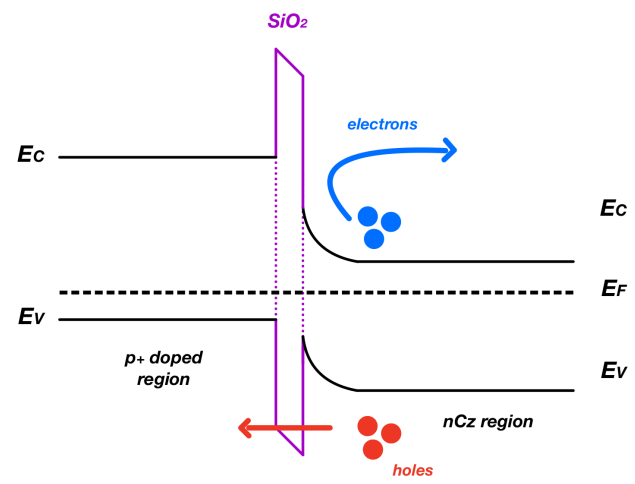
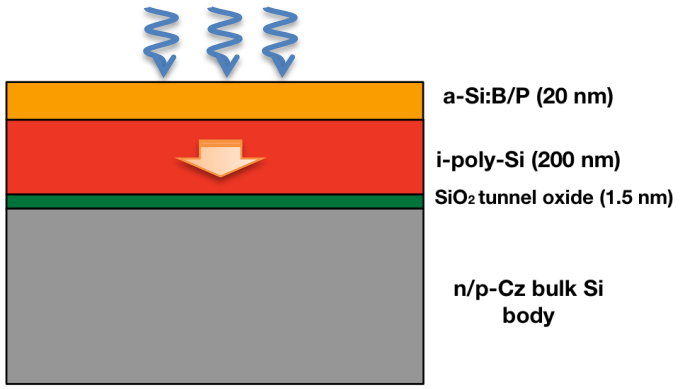
Raman Spectroscopy



Atom Probe Tomography

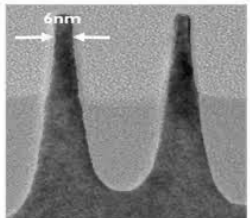
Si doping for advanced photovoltaics (NREL collaboration)

Interdigitated Back Contact solar cells (IBC) with Tunnel Oxide Passivated Contacts (TOPCon)

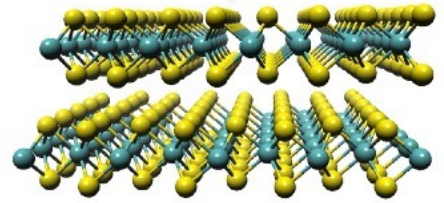


[https://www.lescienze.it/news/2023/02/15/news/fotovoltaico del futuro tecnologie rivoluzionarie grazie a impulsi laser ultra-veloci-11347974/](https://www.lescienze.it/news/2023/02/15/news/fotovoltaico_del_futuro_tecnologie_rivoluzionarie_grazie_a_impulsi_laser_ultra-veloci-11347974/)

Ascent+: Synthesis of 2D Transition Metal Dichalcogenides (EU project)

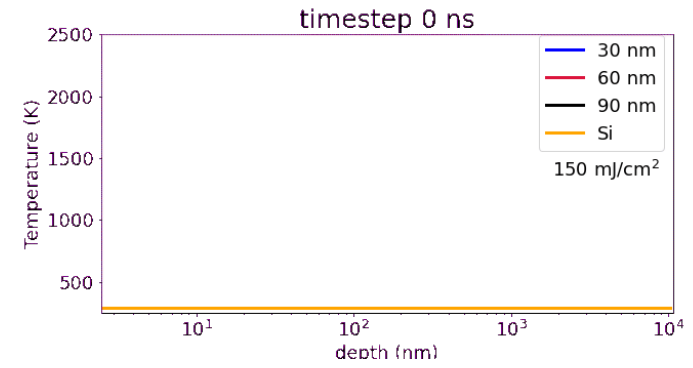
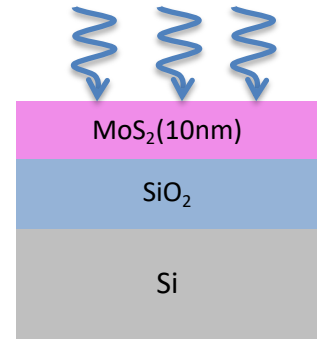


Silicon FinFET

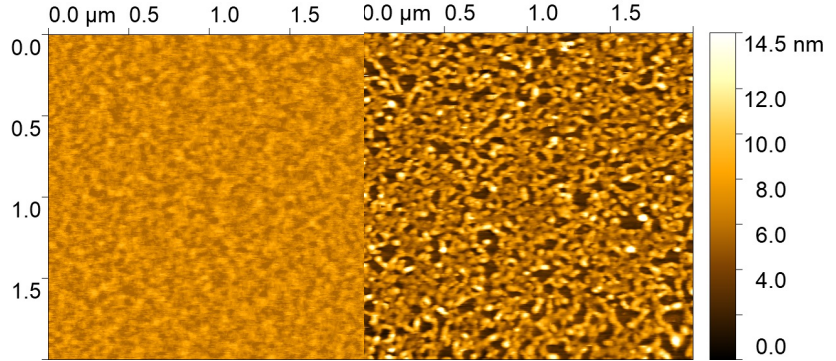


● Mo
● S/Se

Pulsed Laser Processing

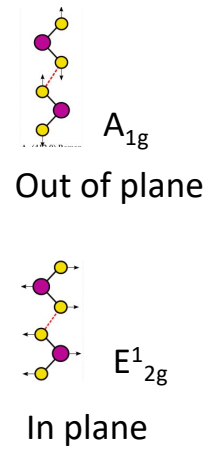
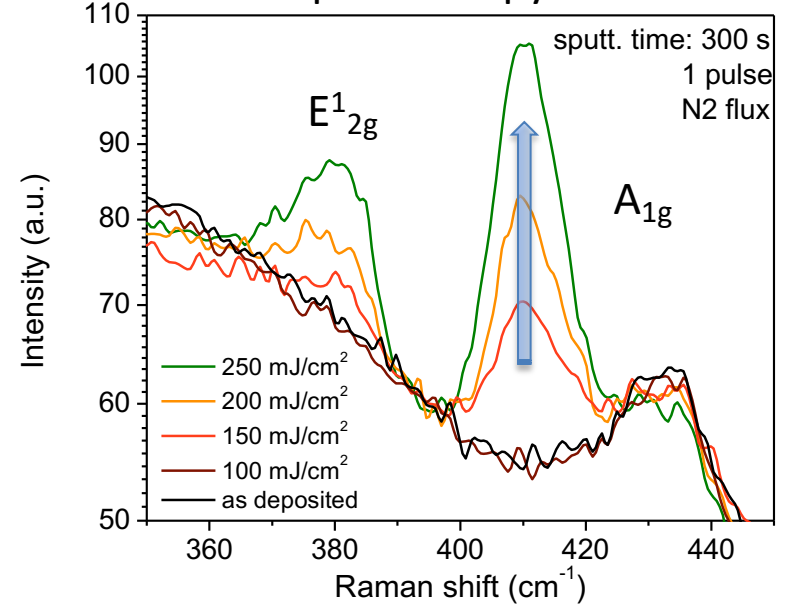


Atomic Force Microscopy

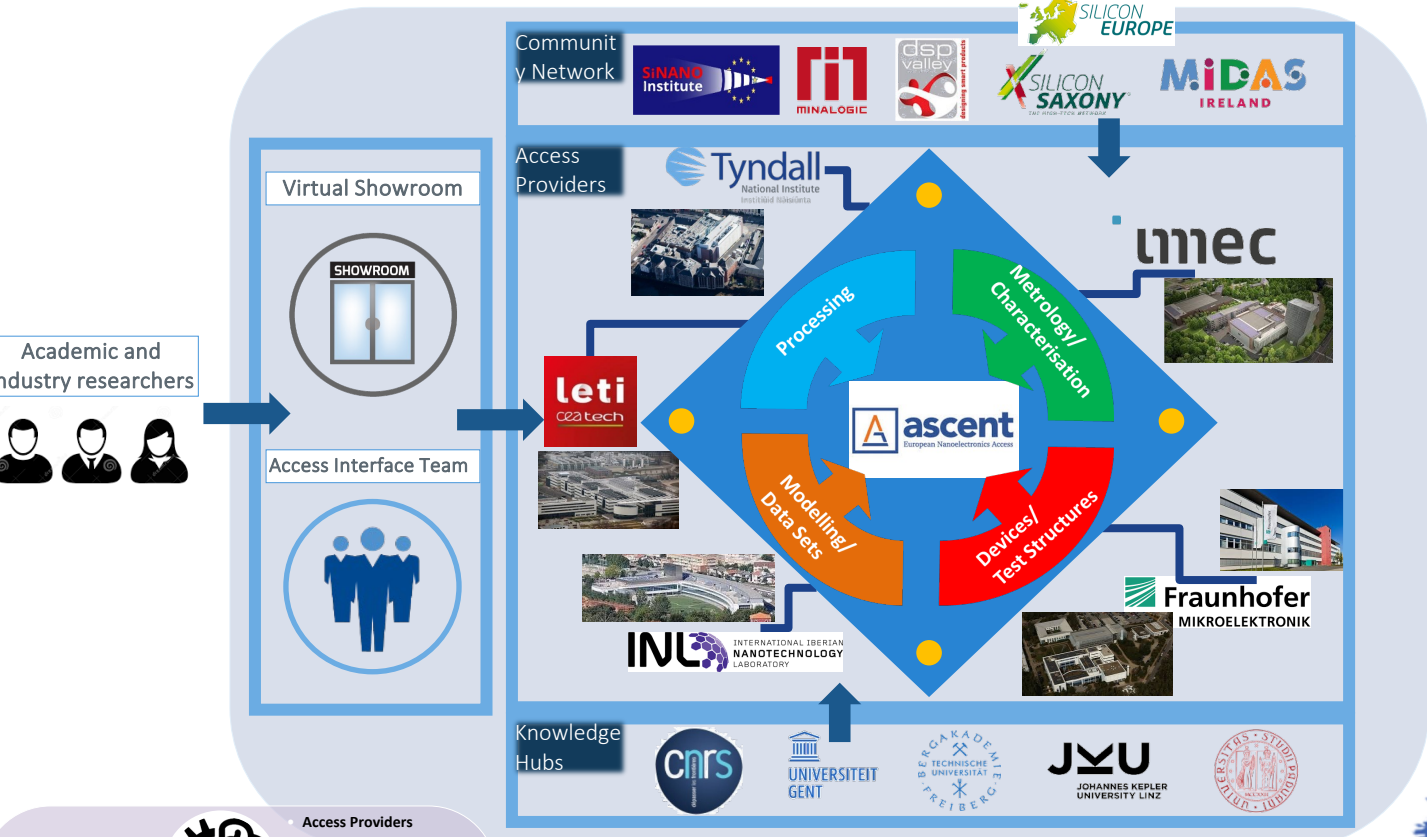


As deposited on Si 300 s, 1 pls 150 mJ/cm² in N₂

Raman spectroscopy



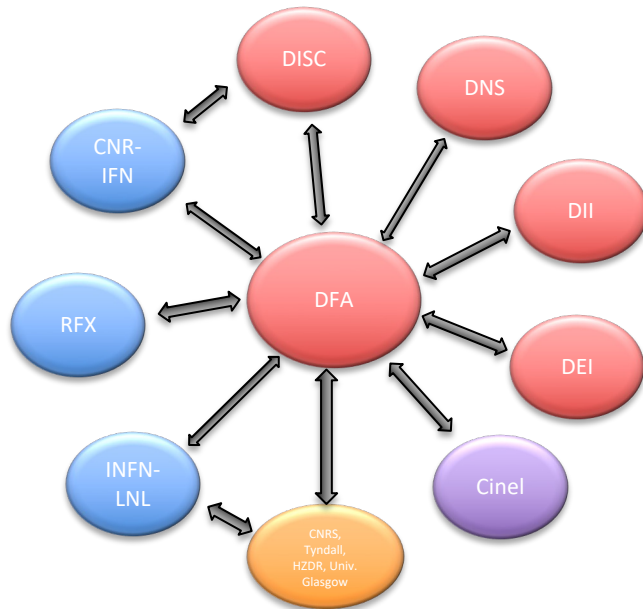
Access to European Infrastructure for Nanoelectronics



- Access Providers**
 - Provide world-leading expertise, advanced equipment and state-of-the-art technologies
- Knowledge Hubs**
 - Deliver frontier research in key domains, contributing to JRAs and feeding to TA offering
- Community Network**
 - Promote, disseminate and interact with user groups and other stakeholders



Unipd project ISR 2017 'SENSITISE'



PNRR project: Partenariato Esteso NEST - "Network 4 Energy Sustainable Transition", Spoke 1: "SOLAR: PV, CSP & CST"

PNRR project: Sustainable Mobility Center - Centro Nazionale per la Mobilità Sostenibile – CNMS, Spoke 13: "Electric Traction Systems and Batteries (ETSB)"

PNRR project: RTDa-SoE SWIRGe - "Micrometer-scale pulsed laser melting for the direct fabrication of infrared photodetector on Ge-on-Si substrates through ex-situ incorporation of deposited metallic elements."

Laser Processing of Semiconductors

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Contatti

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<http://www.dfa.unipd.it/ricerca/linee-e-gruppi-di-ricerca/fisica-sperimentale-della-materia/fisica-dei-semiconduttori-e-dei-cristalli-avanzati/>

https://www.youtube.com/watch?v=GkRmJcDJZ_Y
<http://www.dfa.unipd.it/dettaglio/carosello/dfathesis/>

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