Lifetime measurement in low dimensional structures

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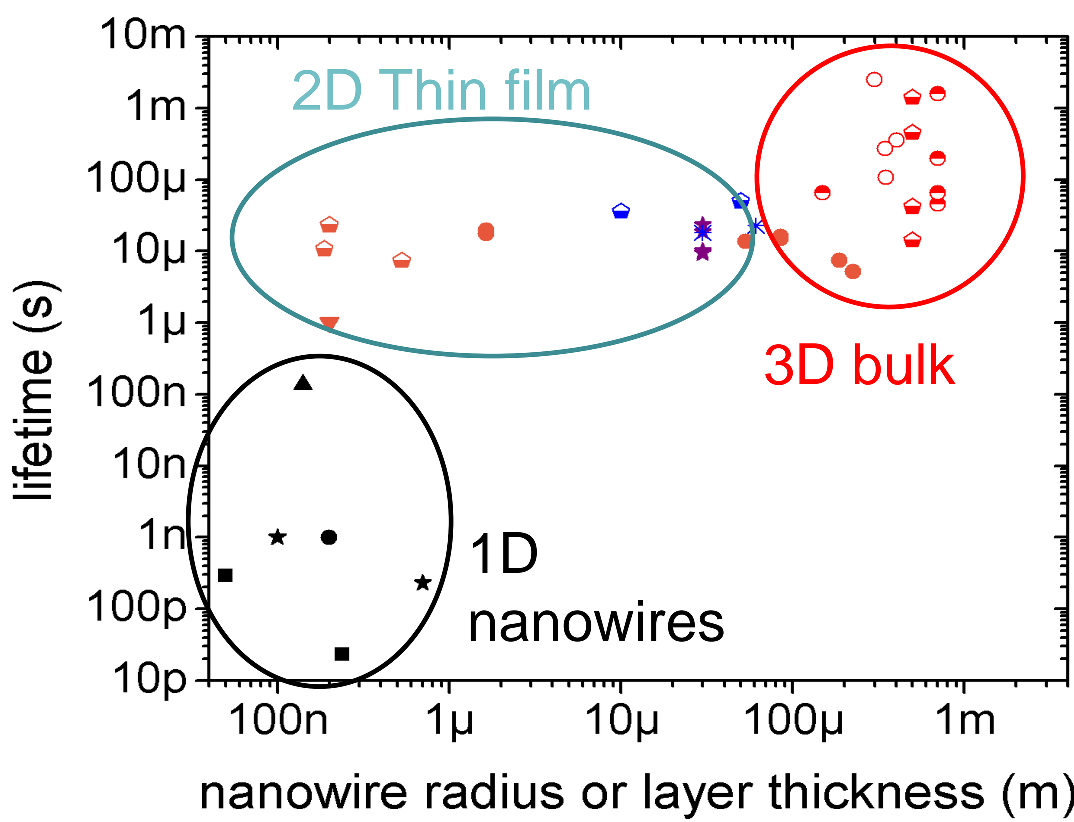
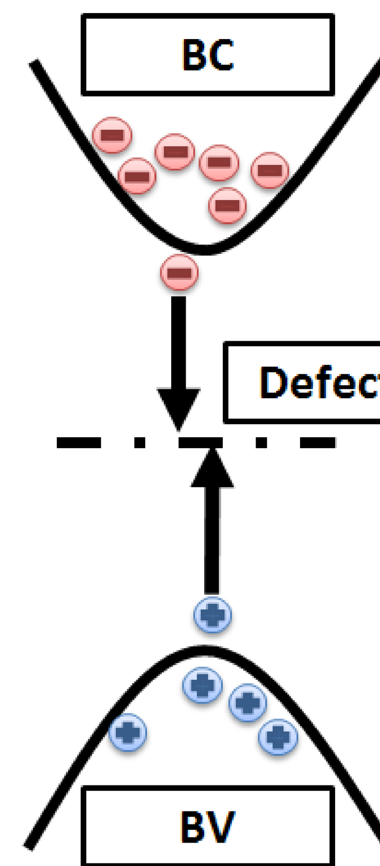


$$\frac{1}{\tau_{eff}} = \frac{1}{\tau_{bulk}} + \frac{1}{\tau_S}$$

τ_{eff} : effective lifetime

τ_{bulk} : bulk lifetime

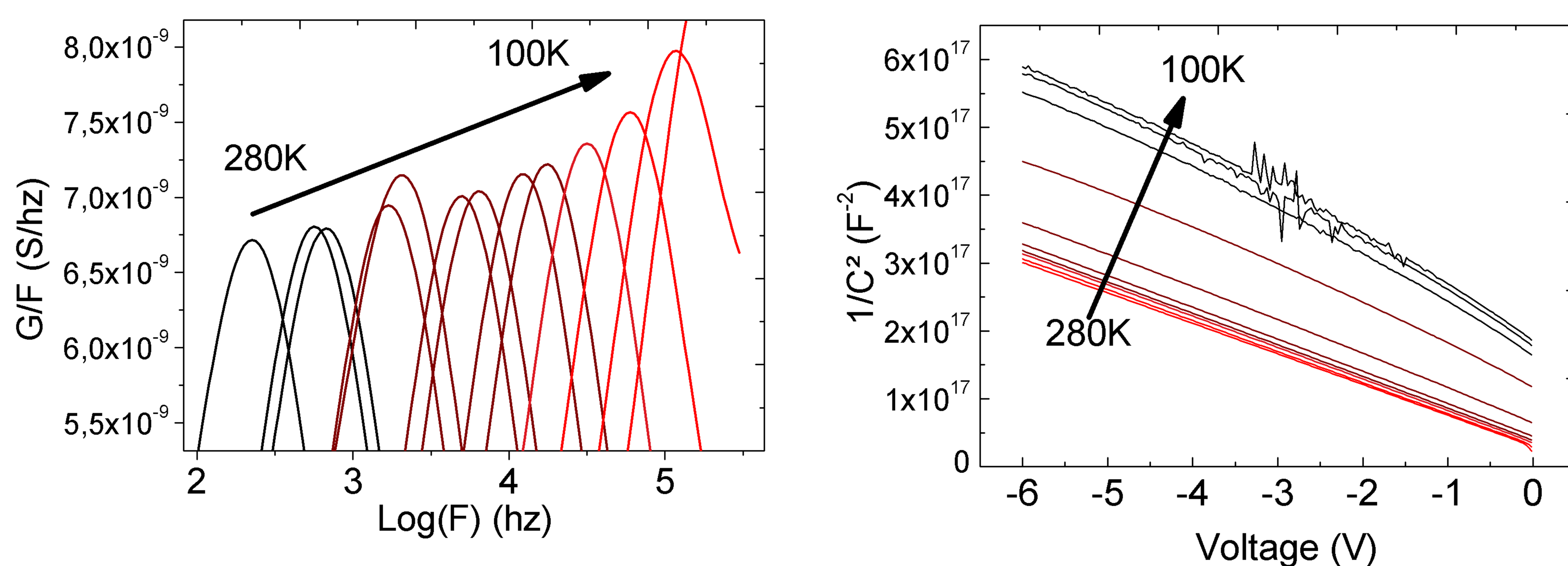
τ_S : surface recombination lifetime



- Defect characterization
  - C-f in temperature.
  - I-V, C-V in temperature.
- Minority carrier lifetime measurement
  - Reverse recovery transient.
  - Photoluminescence.
  - Photoconductance.

Defect characterization

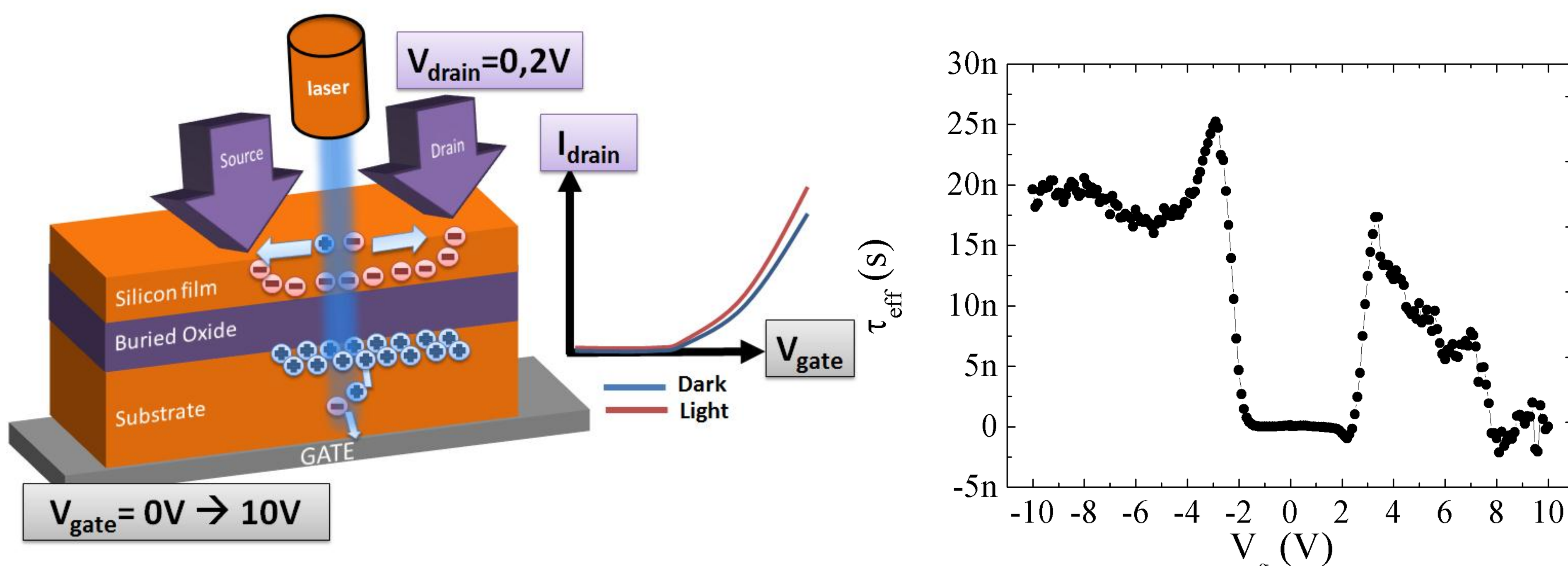
C-f and C-V in temperature



Traps energy level : 0.08eV. Capture cross section : 2.10^{-20}cm². Trap density : $N_t \sim 1.4 \cdot 10^{16}$ cm^{-3}

Interface characterization

Silicon on insulator on Pseudo-MOSFET configuration



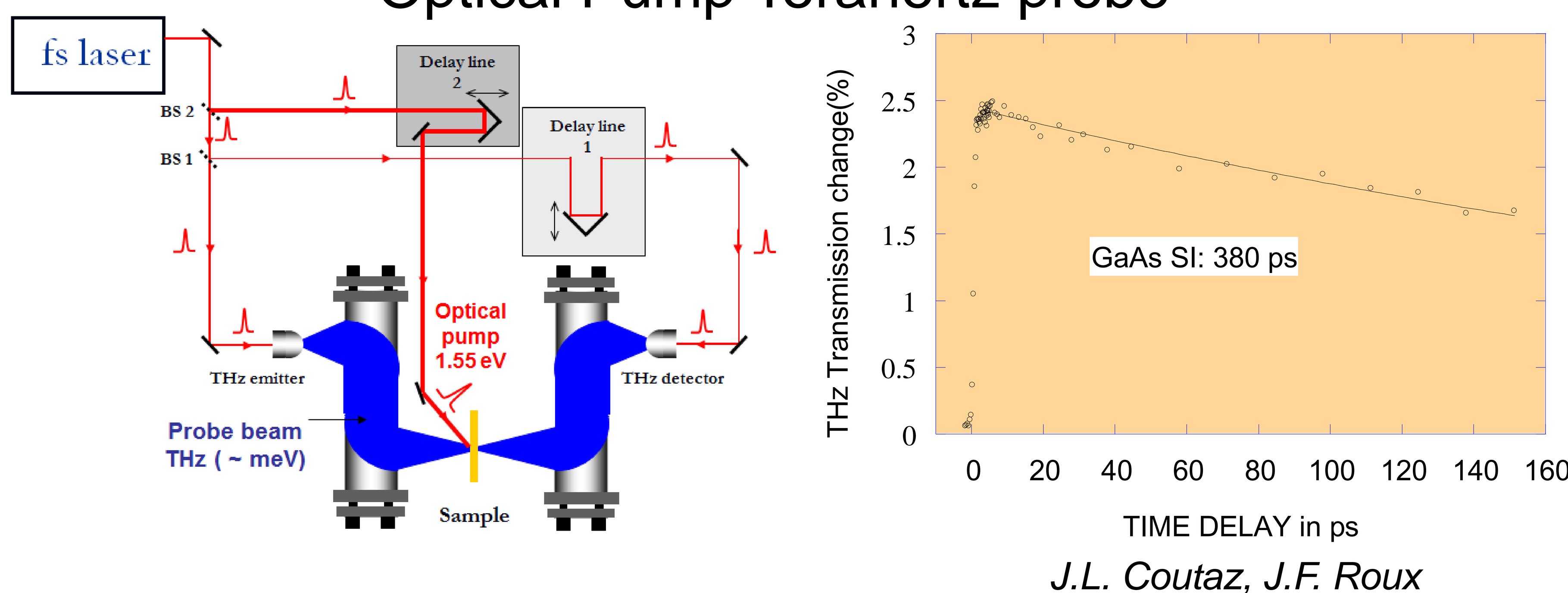
$$S_r = \frac{C_{ox} \times (V_{Tdark} - V_{Tlight})}{q \times (1-R) \times \phi_0 \times e^{-\alpha \cdot t_{si}}}$$

D_{it} (2V) ~ 8.2×10^{11}cm^{-2}.eV^{-1}

$$S_r = \sigma_{trap} \times v_{th} \times k \times T \times D_{it}$$

Lifetime measurement

Optical Pump Terahertz probe



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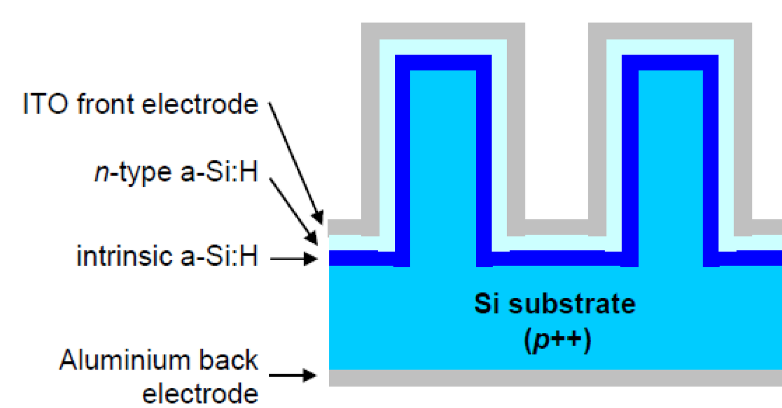
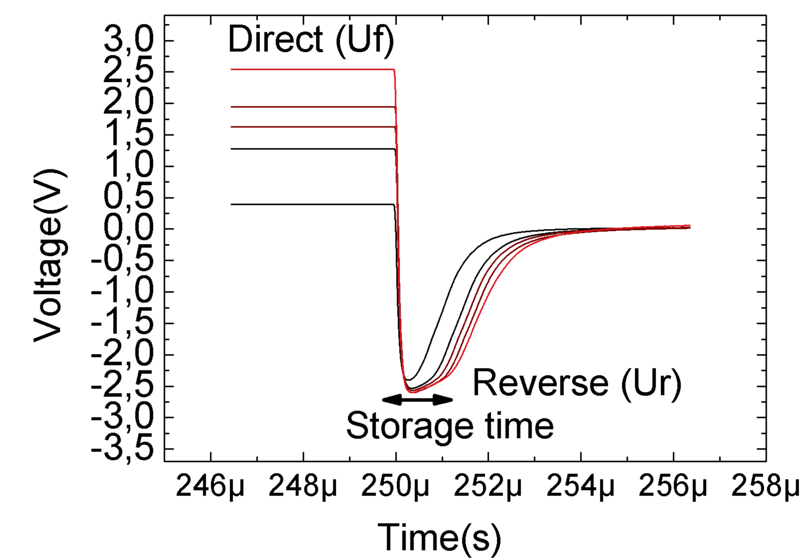
Lifetime measurement

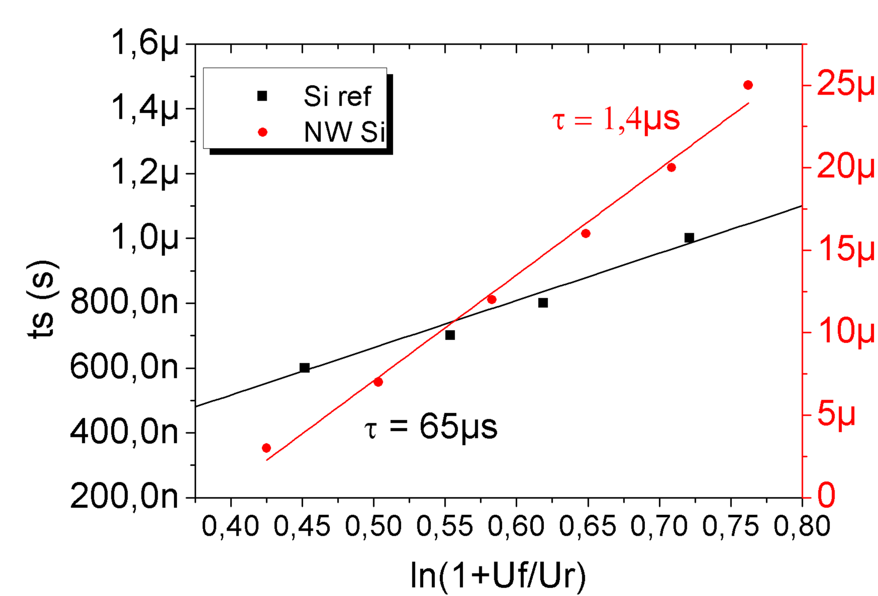
Reverse recovery transient (RRT)

RRT measurements on nanowires based solar cells. Comparison with planar reference solar cells with the same heterojunction and contact.



Nanowire solar cells from CEA Liten.

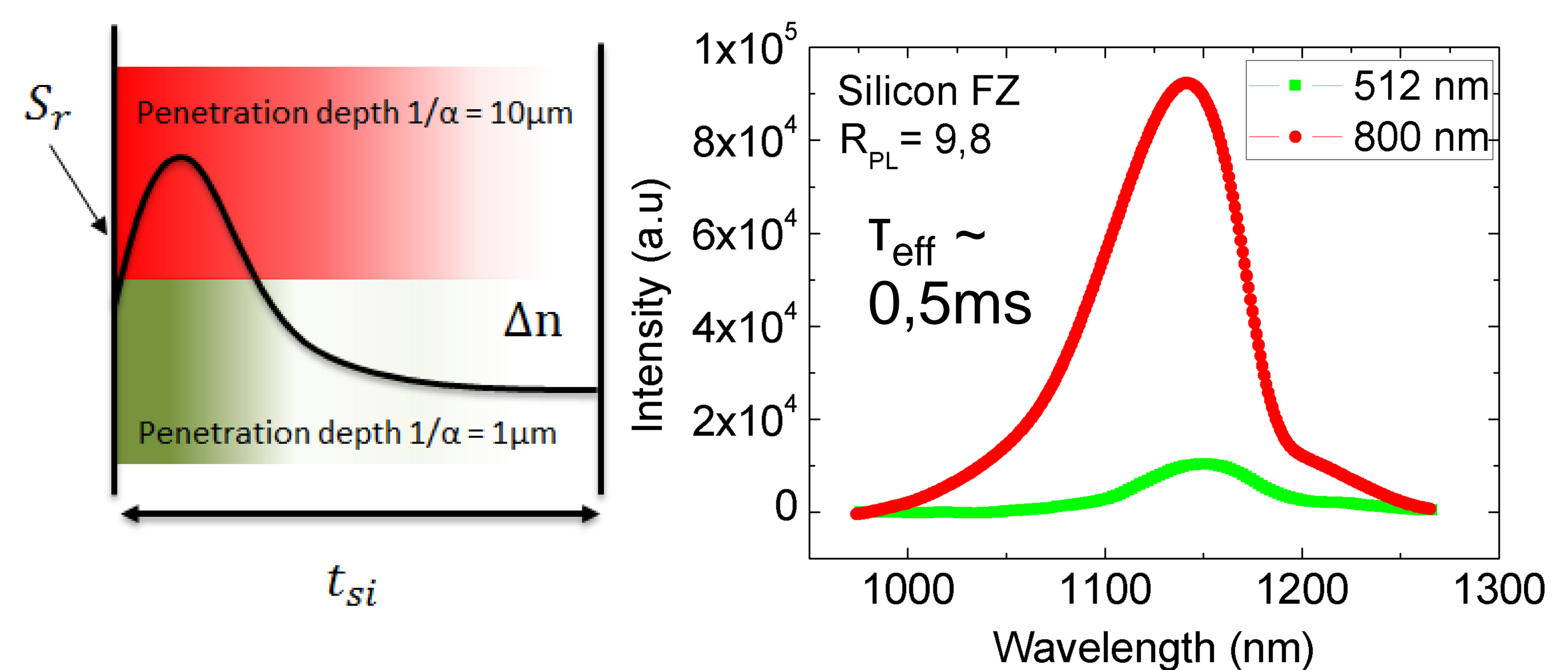




$$t_S = \tau \times \ln(1 + \frac{Uf}{Ur})$$

Lifetime measurement

Photoluminescence with different wavelength



$$\frac{I_{pl}(\lambda_1)}{I_{pl}(\lambda_2)} = \frac{(1 - R_1)\Phi_{\lambda_1} F(\lambda_1, \tau_{bulk})}{(1 - R_2)\Phi_{\lambda_2} F(\lambda_2, \tau_{bulk})}$$