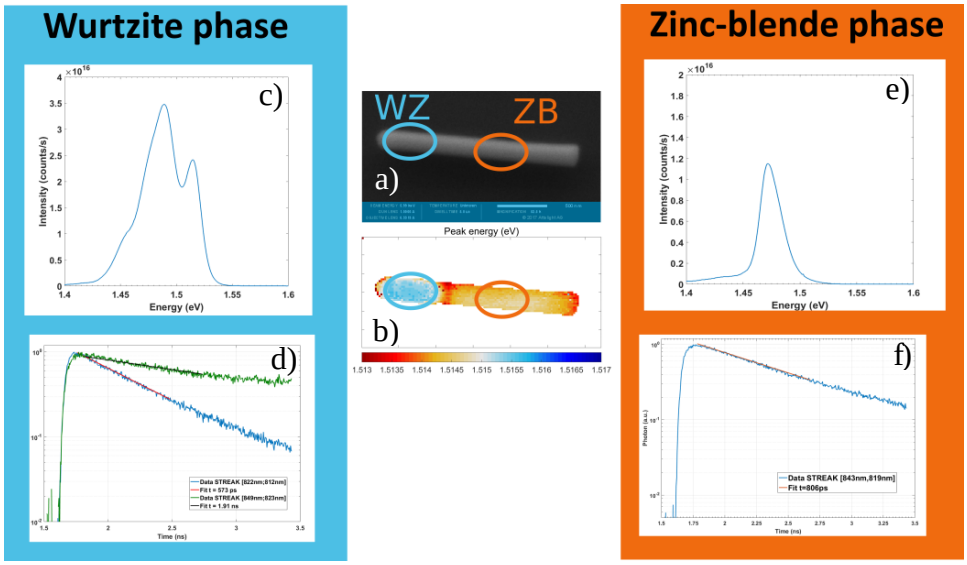
Polarized and time-resolved cathodoluminescence: revealing the properties of zinc-blende and wurtzite phases in a single GaAs nanowire

Thomas Bidaud [a], Hung-Ling Chen [a], Andrea Scaccabarozzi [a], Romaric de Lépineau [a,b], Andrea Cattoni [a], Stéphane Collin [a]

[a] Centre de Nanosciences et de Nanotechnologies (C2N/CNRS), 91460 Marcoussis, (France)
[b] Institut Photovoltaïque Ile de France (IPVF), 91120 Palaiseau, France
thomas.bidaud@c2n.upsaclay.fr

III-V solar cells hold record efficiencies for single-junction and tandem solar cells, but cost reduction is needed for large-scale development of III-V in photovoltaics. The direct growth of III-V nanowires (NWs) on silicon appears as a promising path toward low-cost III-V/Si tandem solar cells. However, new characterization techniques need to be developed to optimize the growth conditions, to control dopant incorporation and to assess the quality of III-V NWs.

We present high-resolution cathodoluminescence (CL) mapping of single GaAs nanowires and reveal distinct segments of zinc-blend (ZB) and wurtzite (WZ) phases. Using polarimetric CL, we show that the luminescence from the WZ segment can be distinguished unambiguously. This unique technique allows to reveal and compare the properties of undoped, p-doped and n-doped WZ and ZB GaAs: luminescence intensity, bandgap, doping level and defects. Moreover, we use a pulsed electron beam to perform time-resolved CL measurements in each segment and provide lifetime measurements of carriers at the nanoscale.



Figures : a) SEM image of GaAs-I b) Peak energy cartography of a single nanowire c) WZ phase spectra d) WZ decays measured on STREAK nanowire τ(ZB)=1.91ns and τ(ZB)=573ps e) ZB phase spectra f) Zinc Blende decay measured on STREAK τ(ZB)=806ps