Defects in ZnO nanowires

Heating, ion bombardment and contacts

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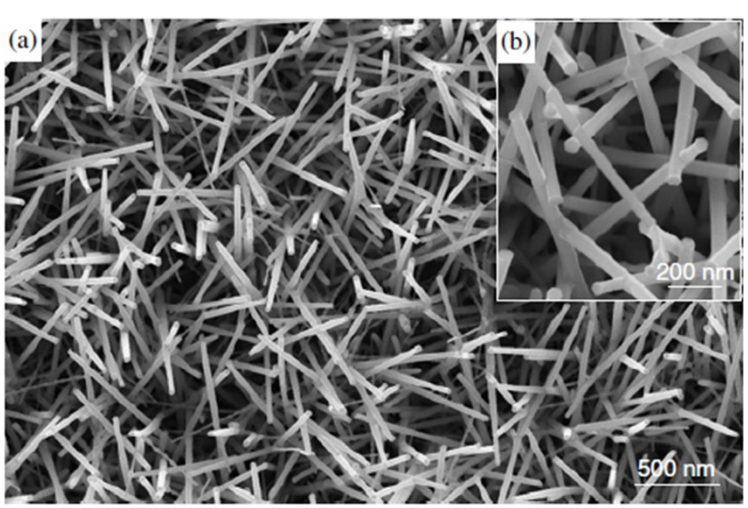
4th Int. Conf. on Nanotek & Expo
Mon 1st December 2014

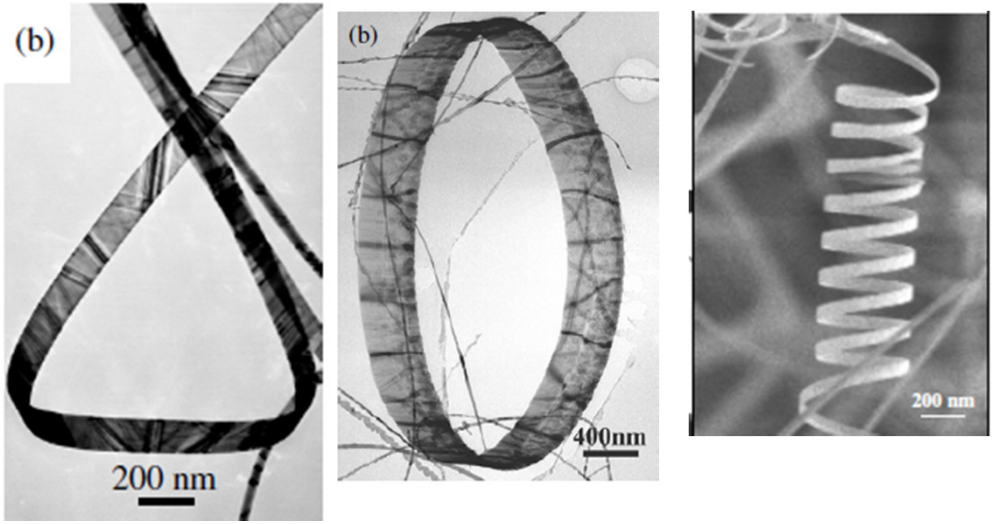
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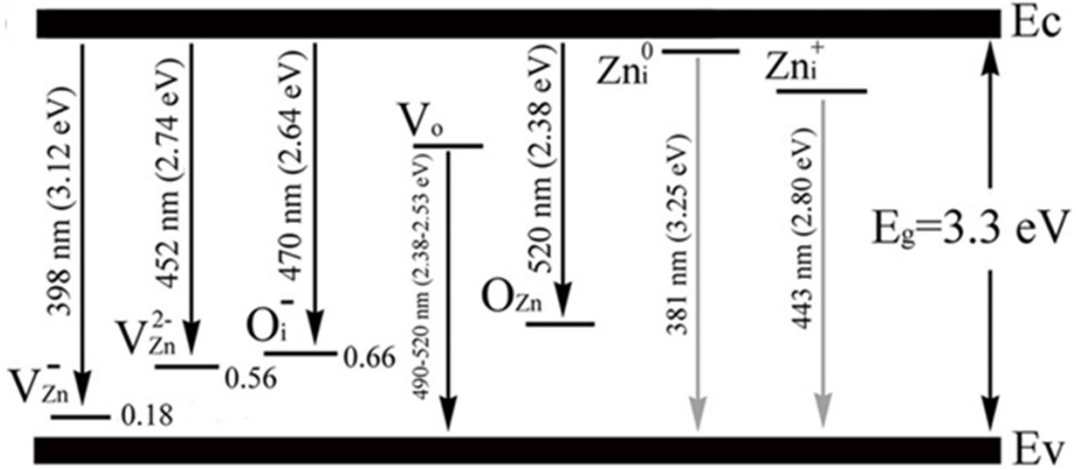
ZnO nanostructures and defects





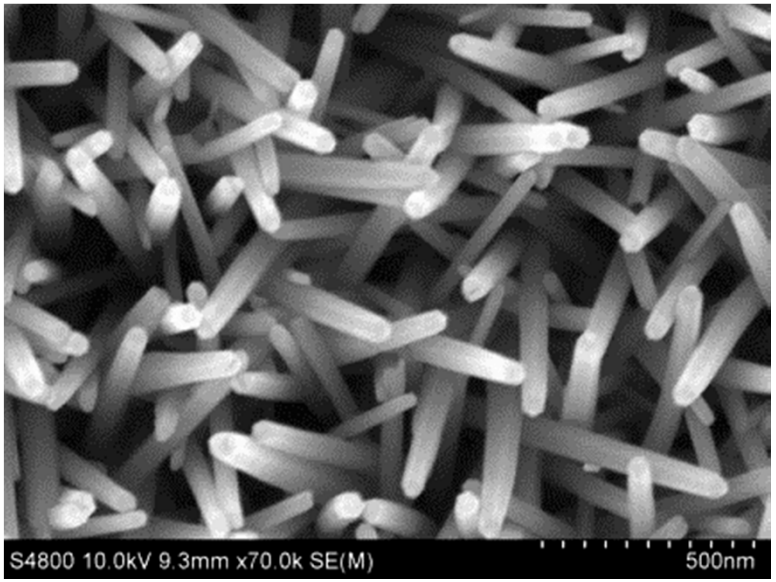
Z.L. Wang, J. Phys.: Condens. Matter 16 (2004) R829-R858

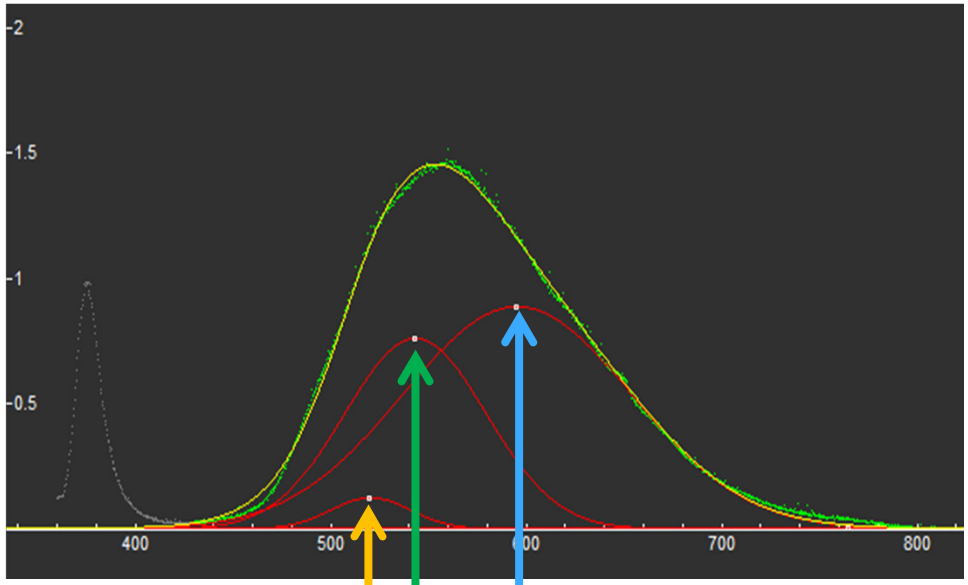
- Properties
- Structures and devices
- Defects



Liu, J., et al, J. Phys. D: Appl. Phys., 2009. **42**(9): p. 095401.

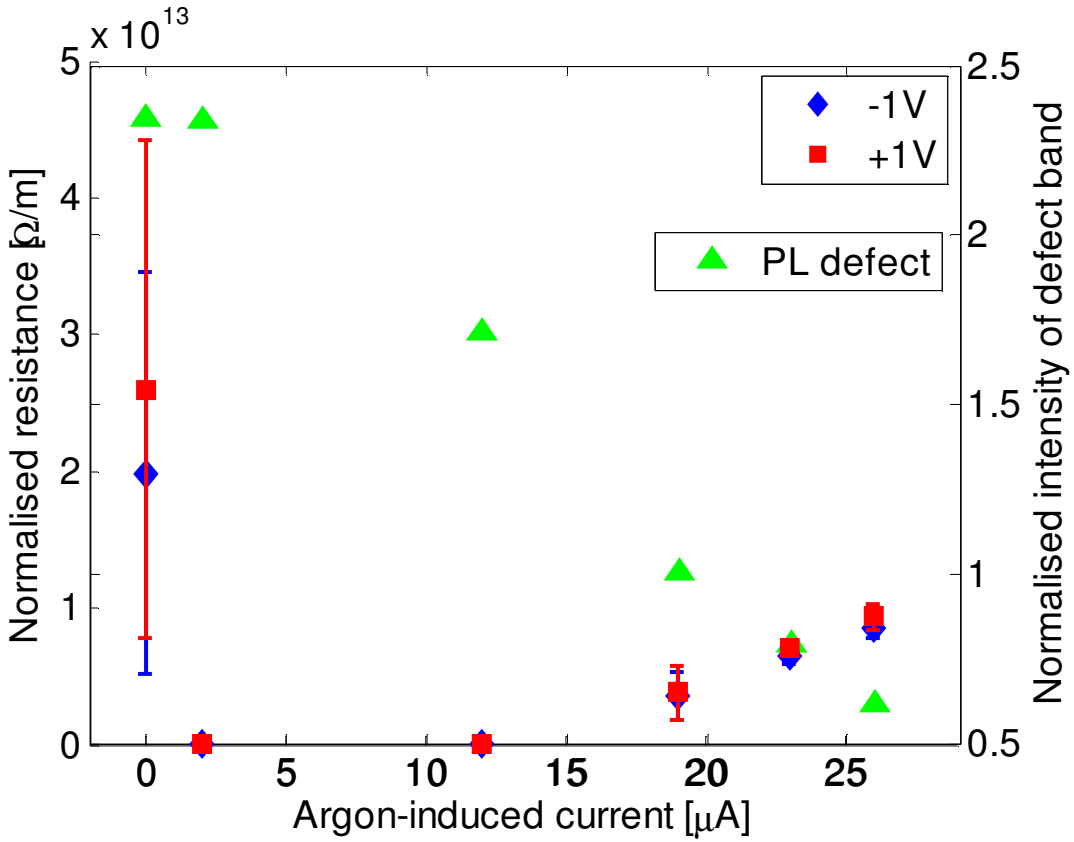
Growth, control of defects and motivation

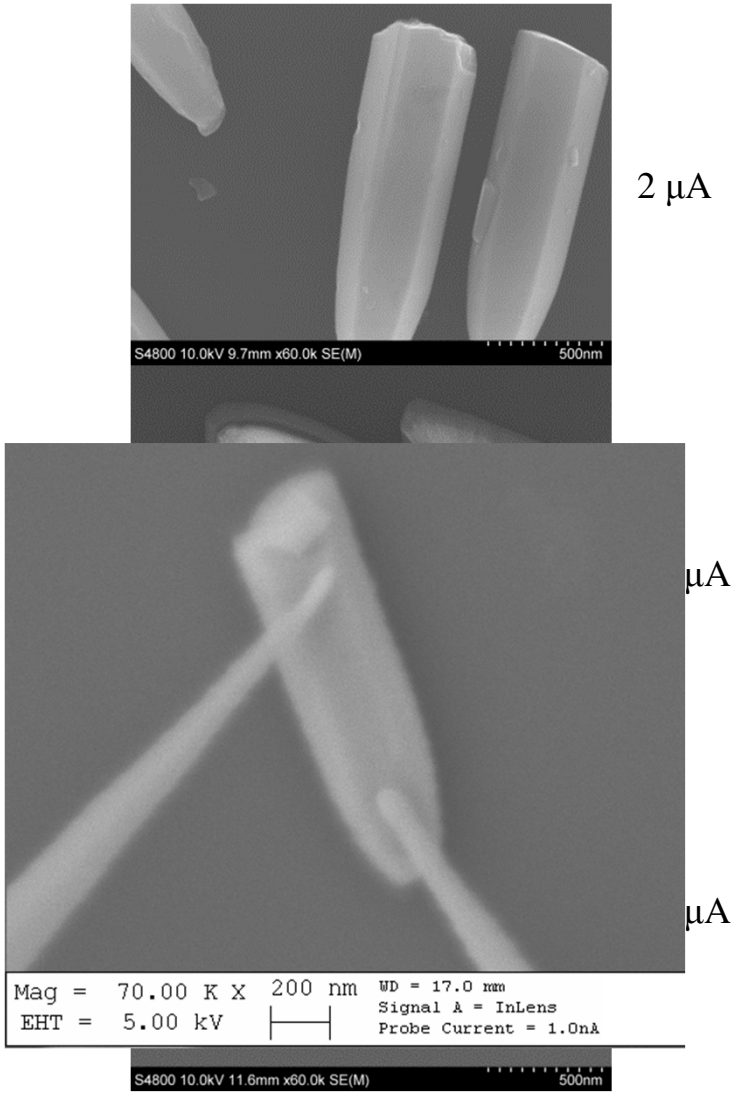




- Control and evolution of defects with argon bombardment and annealing
- Role of defects on conductivity, transport, contacts and sensing

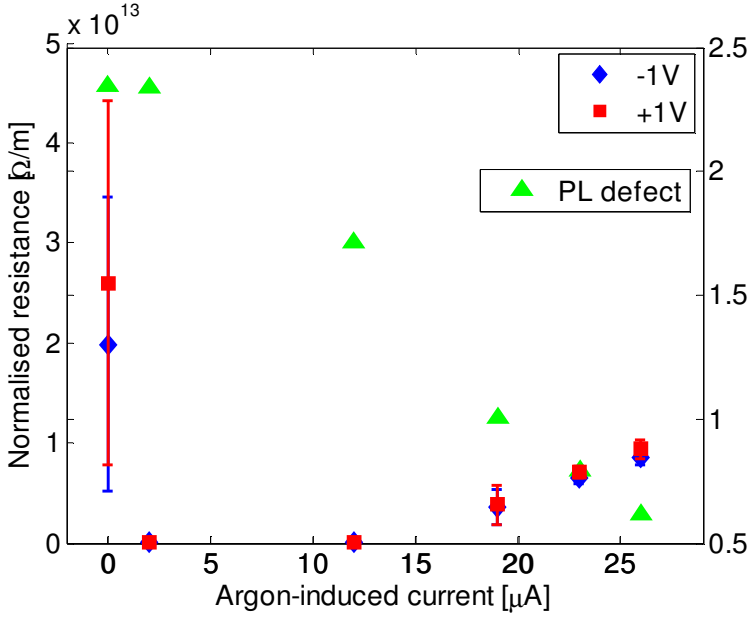
Effect of argon bombardment

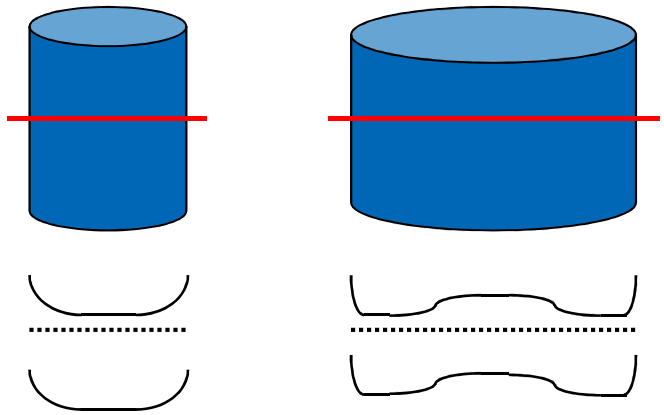


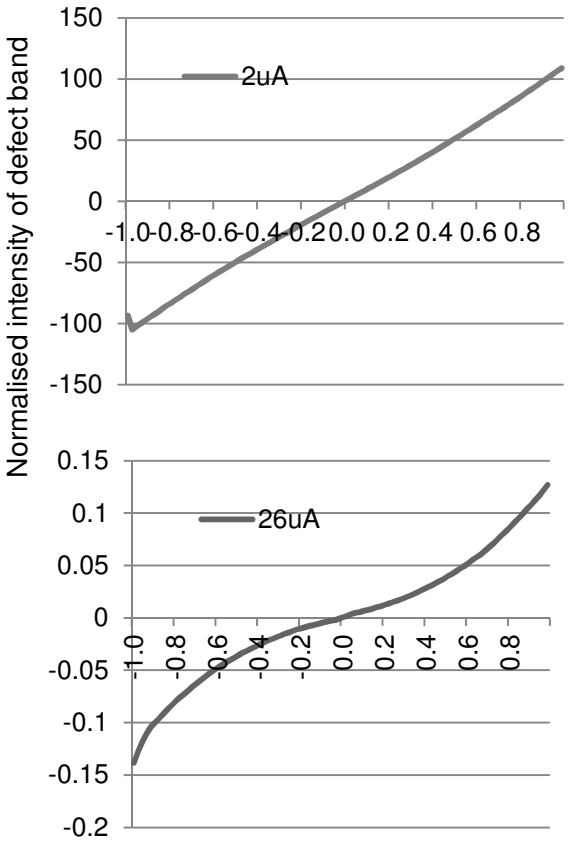


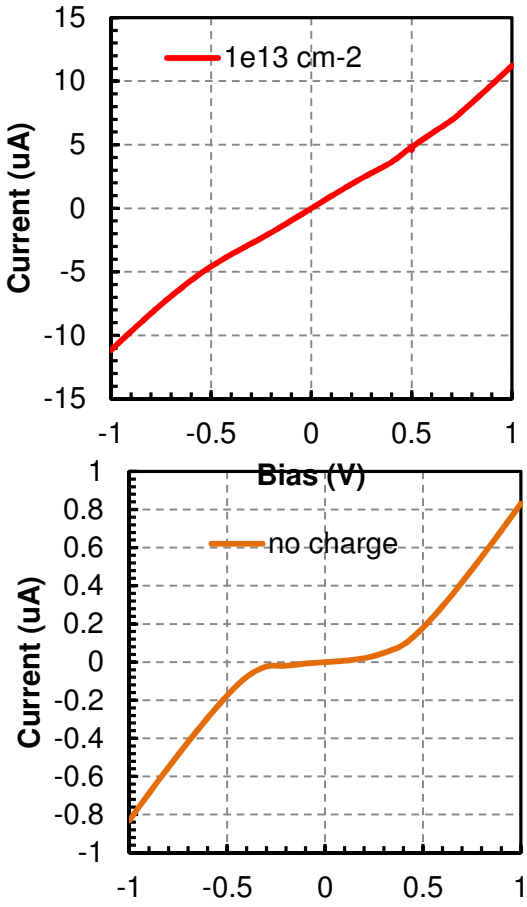
1. Damage (PL)
2. Ar implantation (EDS)
3. Chemistry (XPS)
4. Etching?

Argon bombardment -> model of NW defects



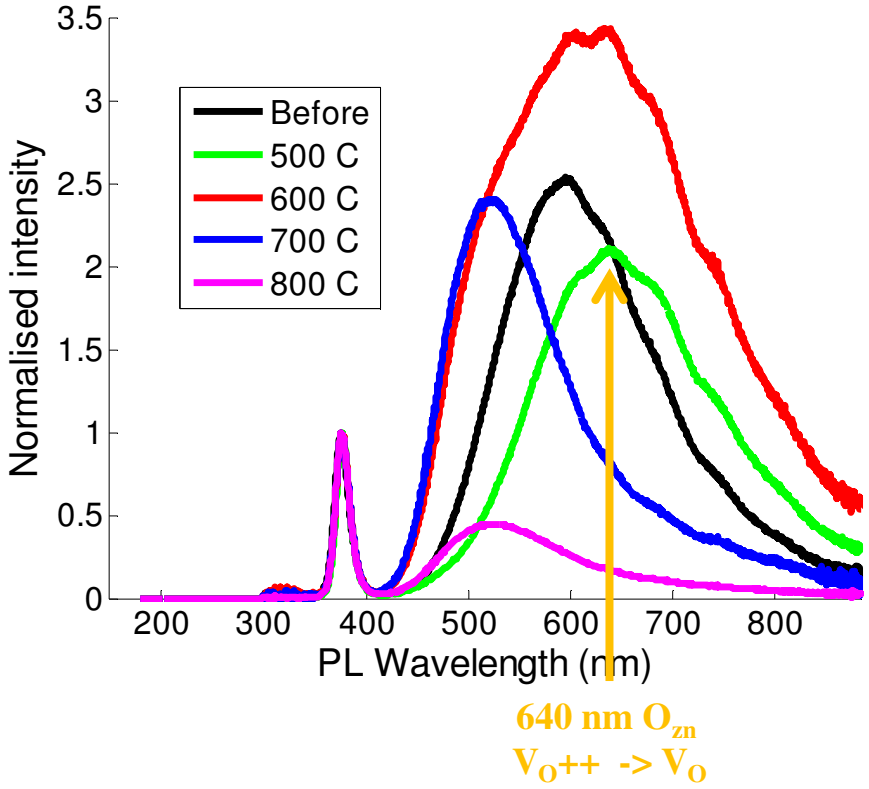


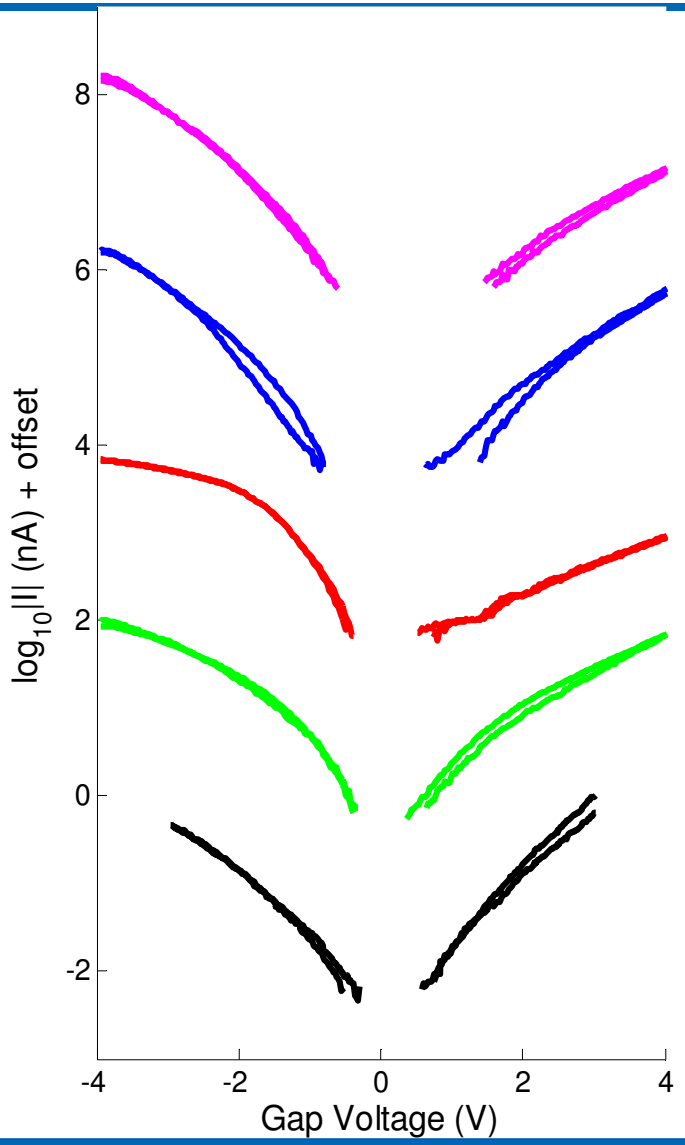




1. Clean (no +defect)
2. PL not surface
3. Pitted -> sensor
4. Band model?

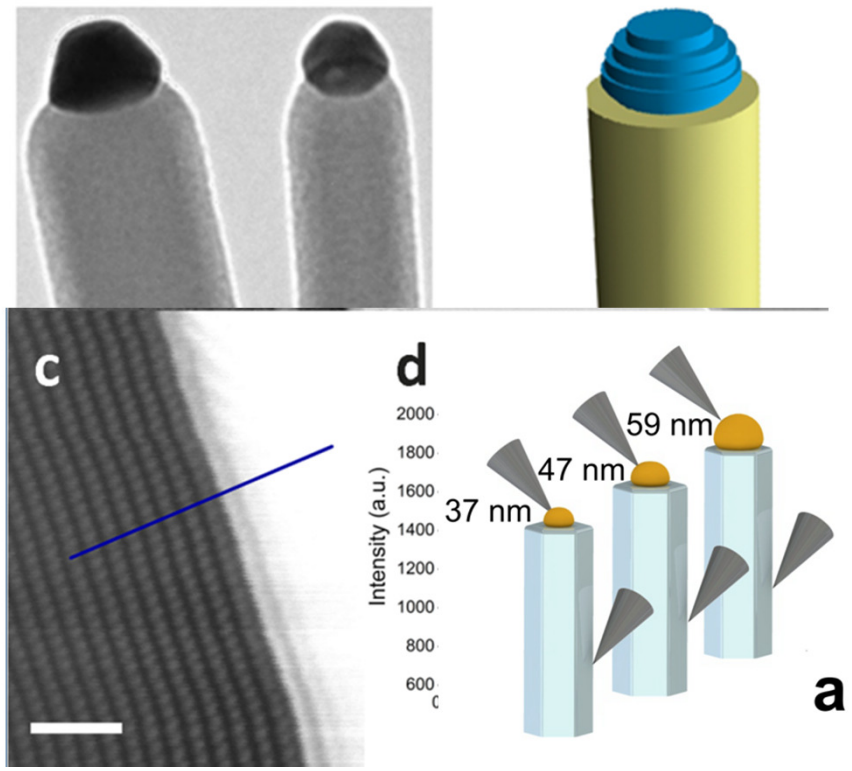
Effect of heating on hydrothermal ZnO NWs

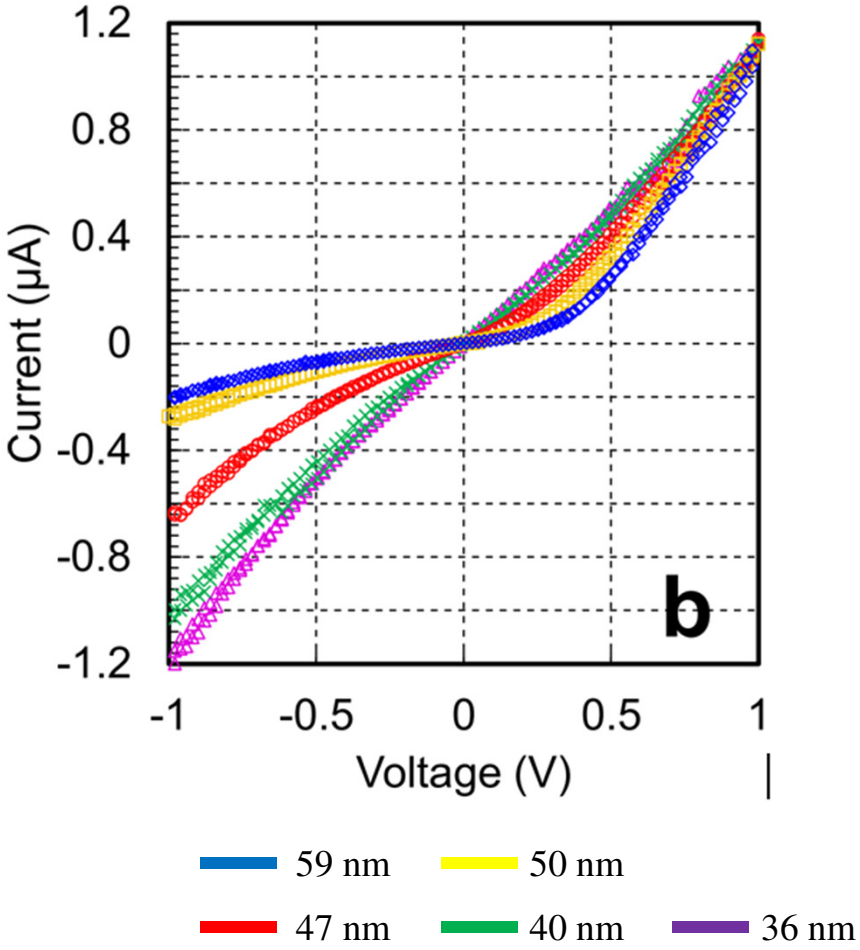




1. 500 C Cleaning
2. 600 C Donors + acceptor states present
3. >=700C Donors reduced, acceptors

ZnO NW – role of contacts





"Controlling the electrical transport properties of nanocontacts to nanowires", In preparation,
AM Lord, TG Maffeis, O Kryvchenkova, RJ Cobley, K Kalna, DM Kepaptsoglou, QM Ramasse, AS Walton, MB Ward, J Köble, SP Wilks

Conclusion – ZnO NWs

- Ohmic contacts possible with light Ar treatment, without additional defects
- Surface pitting with intermediate Ar, more surface but still with Ohmic contact -> better sensing?
- Heating alters the ratio of donors and acceptors?
- Growth surface defects very localised to surface – can be removed by a light argon treatment
- PL not dominated by surface -- probing bulk of wire?
- In wide NWs the defect density drops towards centre -> current in a ring? Larger wires still surface sensitive?