Germanium nanowires grown on different substrates: glass, germanium, silicon

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Abstract (300 word limit)

Devices based on nanowires semiconductor structures have raised a big interest during the last decades. In this framework, germanium is emerging as an alternative to silicon thanks to its higher carrier injection velocity, lower effective mass, higher mobility, larger Bohr radius enhancing carrier confinement and lower temperature growth and processing. It is currently being studied for application in molecular sensors, nanophotonic components, high-speed transistors.

In this work we report on germanium nanowires grown on different substrates. Beside the standard silicon and germanium, we show a direct growth of the nanostructures on amorphous glass.

The nanowires were grown by Metal Organic Vapor Phase Epitaxy (MOVPE) using isobuthyl germanium as precursor. We show how the substrate influence the growth direction of the nanowires, and how different growth parameters can affect the final nanostructures.

We make a comparison between NWs grown on monocrystalline substrates and NWs grown on glass. The results show that the substrate does not affect any of the relevant morphological, crystallographic or electrical properties of Ge NWs.

The lengths of our nanowires are in the 20-30 micrometer range with minimal tapering. TEM and Raman characterization show a very good crystallinity of measured nanostructures, regardless of the substrate used.

Our findings demonstrate that very long Ge NW with minimal tapering can be obtained and that glass is a valid option as cheap substrate for the mass production of these nanostructures.

Image

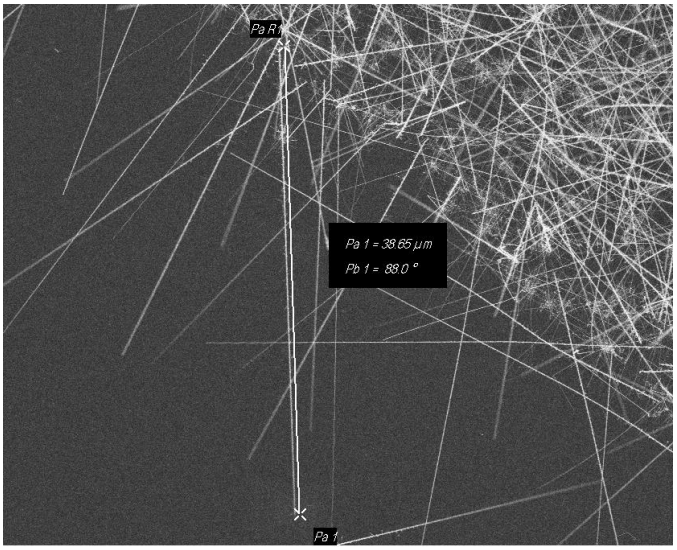


Figure 1: Ge NW grown on glass substrate

Recent Publications (minimum 5)

1. S. Beretta, M. Bosi, L. Seravalli, P. Frigeri, G. Trevisi, E. Gombia, F. Rossi, D. Bersani, C. Ferrari, "Direct growth of germanium nanowires on glass" Nanotechnology 31 (2020) 394001
2. S.Beretta, M.Bosi, L.Seravalli, N.Musayeva, C.Ferrari "Orientation of germanium nanowires on germanium and silicon substrates for nanodevices", Materials Today: Proceedings 20 (2020) 30
3. L. Seravalli, M. Bosi, S. Beretta, F. Rossi, D. Bersani, N. Musayeva, C. Ferrari, "Extra-long and taper-free germanium nanowires: use of an alternative Ge precursor for longer nanostructures" Nanotechnology 30 (2019) 415603
4. M. Bosi, L. Seravalli, S. Beretta, C. Ferrari, "Growth of germanium nanowires with isobuthyl germane" Nanotechnology 30 (2018) 084002
5. M. Bosi, P. Mazzolini, L. Seravalli, R. Fornari "Ga_2O_3 polymorphs: tailoring the epitaxial growth conditions" Journal of Materials Chemistry C, 32 (2020) 10975



Biography (150 word limit)

Matteo Bosi works as a researcher in IMEM CNR (Parma, Italy). He has expertise in epitaxy of semiconductors and his activities includes MOVPE growth of gallium oxide for novel solar-blind UV-C sensors, germanium nanowires for sensing and 2D MoS_2 synthesis.

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