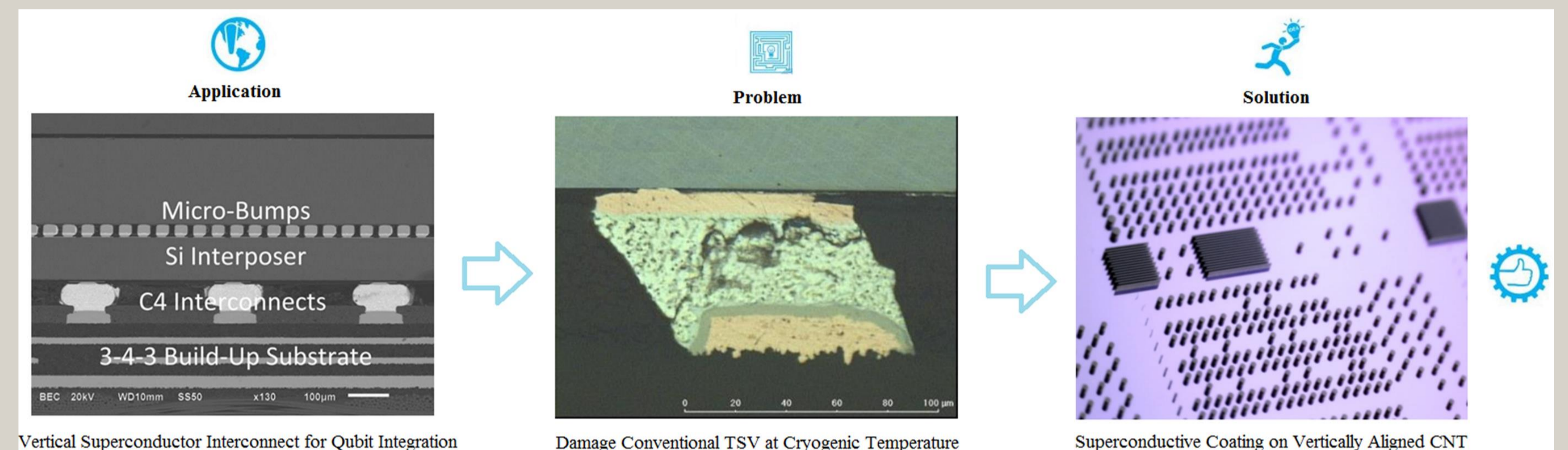
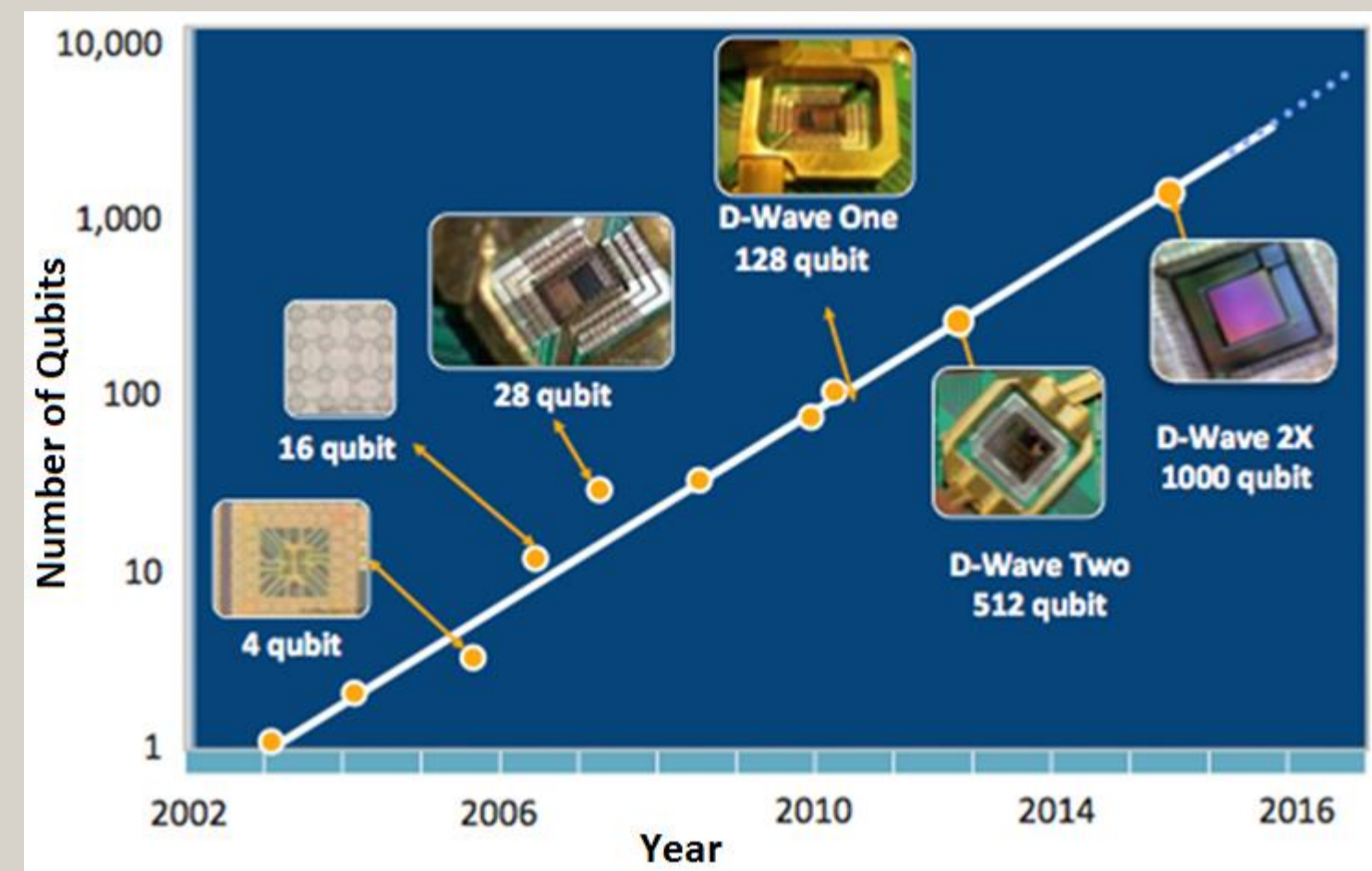


Superconducting Carbon Nanotubes Composite as Vertical Interconnect for Qubit Integration at Cryogenic Temperature

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Introduction and Problem Statement

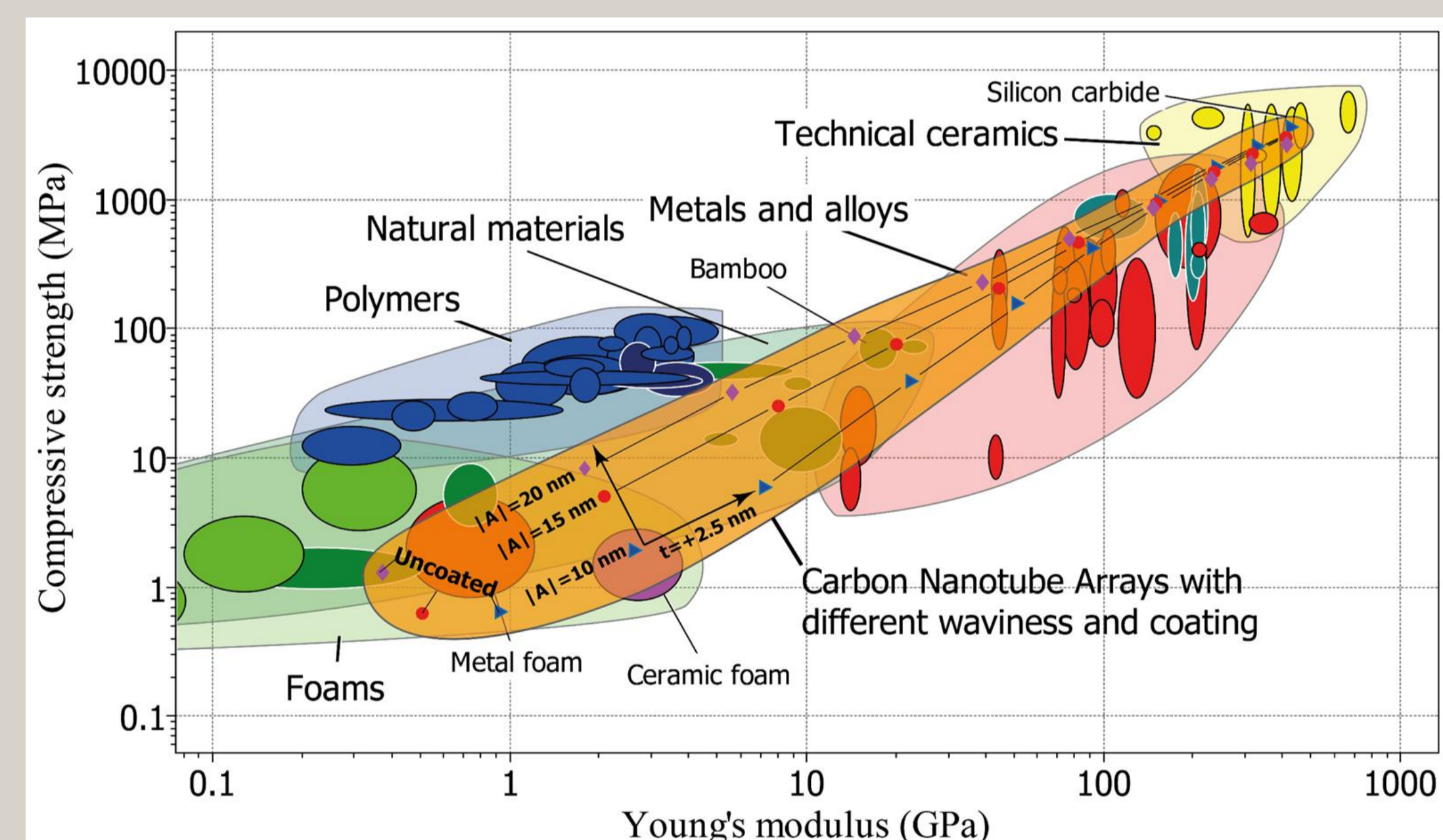
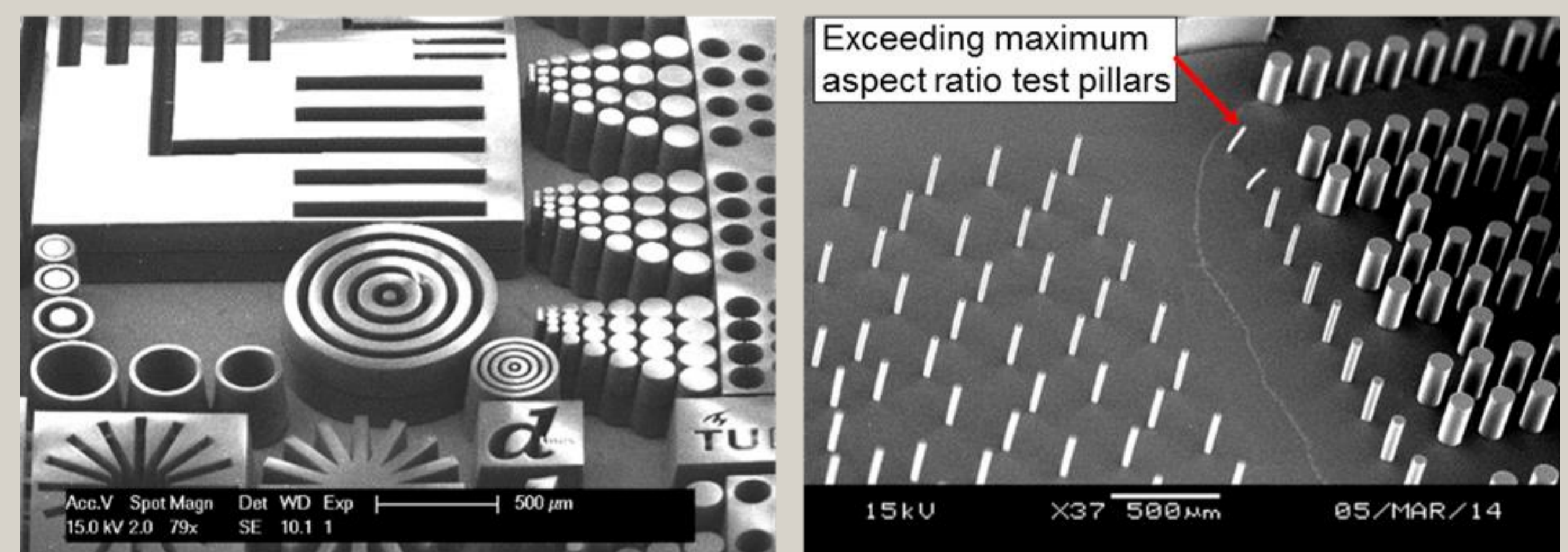
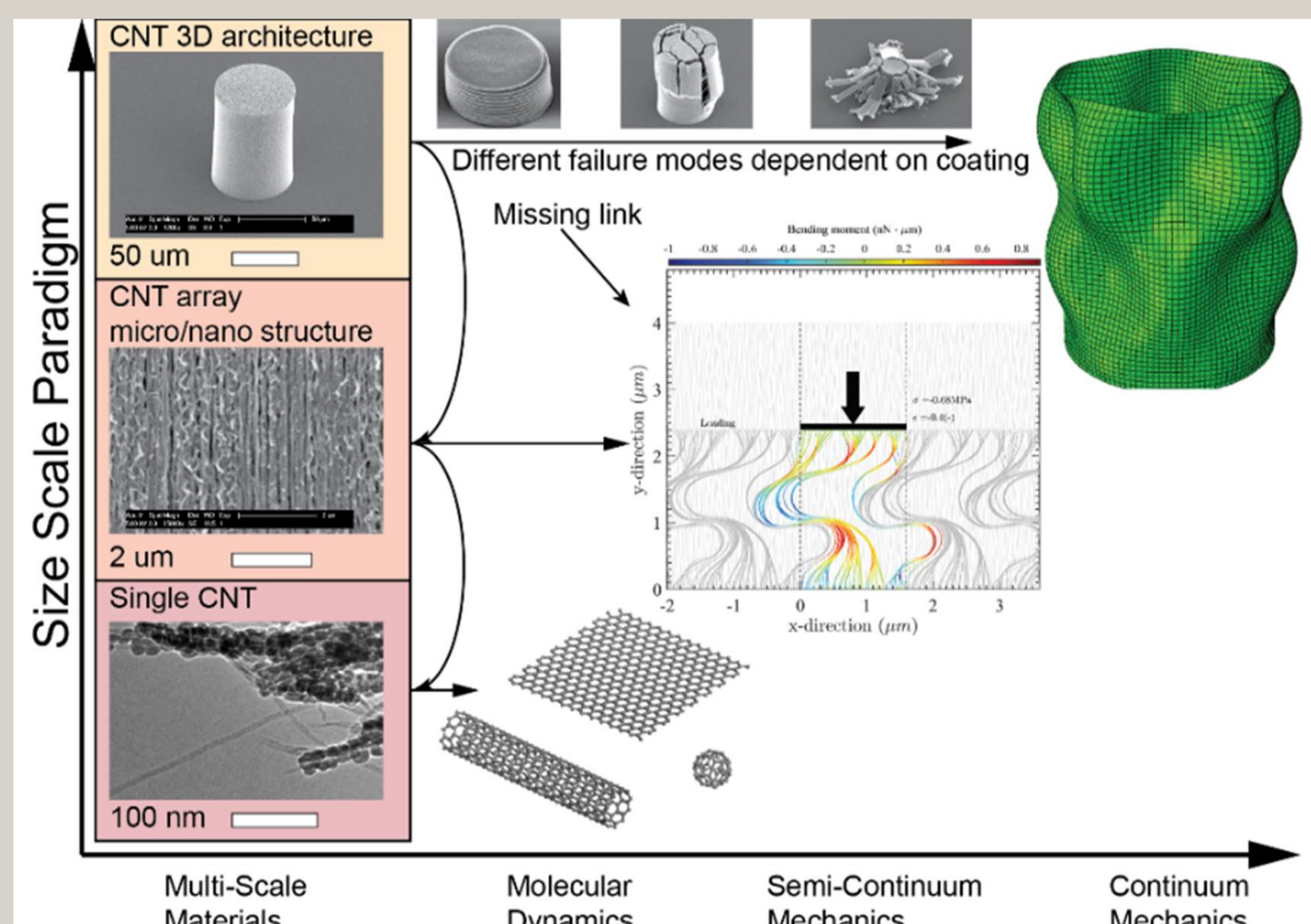
Efficiently integrating many qubits with vertical superconductor interconnects that carry the quantum information through the silicon wafer is of vital importance, which should be reliable, fine-pitch, and high aspect ratio. commonly used TSV materials (Cu or Al) reach superconductivity below 1K. On the other hand, Niobium has the highest superconducting temperature of elementary superconductors at 9.2K, but mechanically unreliable at cryogenic temperature.



Research

We are aiming to fabricate and characterize the vertical interconnect for qubit integration made from novel composite of carbon nanotube arrays with superconductor coating. The main objectives include:

- Vertical CNT array bundle growing on different substrates and optimization of the CVD process;
- Conformal superconductor coating with different materials and thicknesses on CNT with ALD;
- Characterizing the mechanical and electrical properties of the composite at room and cryogenic temperatures.



Networking and collaboration

- R.H. Poelma and G.Q. Zhang; Department of Electronic Components, Technology and Materials, TUDelft, The Netherlands.
- R. Ishihara; QuTech and Kavli Institute of Nanoscience, TUDelft, The Netherlands.
- C.P. Wong; School of Materials Science and Engineering, Georgia Institute of Technology, USA.

Planning and foreseen results

- Using the NbN and TiN as a substrate for growing CNT
- Coating the CNT with NbN and NbTiN superconductors
- Reaching to vertical composite of CNT/superconductor interconnect with high superconductivity temperature and good mechanical stability
- Investigate the main failure mechanism of the manufactured interconnects at cryogenic reliability

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