Scalable Method for Braiding Majorana Modes in Topological Superconductor

DeepTech

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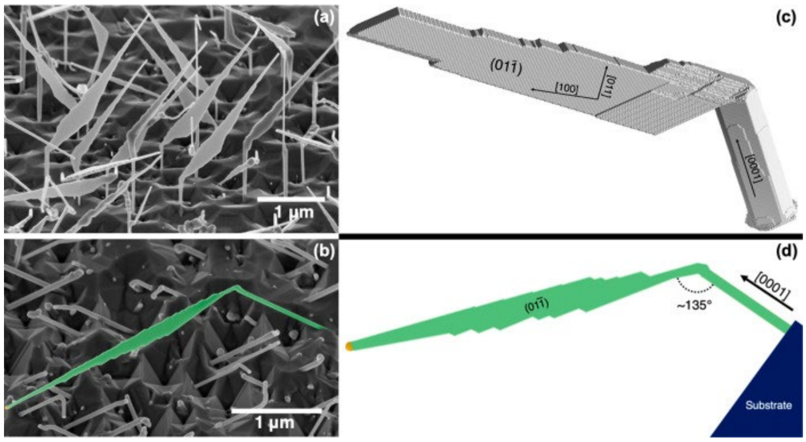
Quantum computing requires reliable control and braiding of Majorana zero modes. These modes emerge in topological superconductors and enable exceptionally stable quantum operations but are highly sensitive to noise and geometric imperfections. Current architectures depend on multiple nanoscale gates that demand delicate tuning. This invention introduced single-gate, self-tuned nanowire geometry, using tapered quasi-1D topological superconductors, that enables natural formation, movement and braiding of Majorana modes with minimal calibration, providing a scalable and robust platform for topological quantum computation.



Kinked InAs NWs. As-grown kinked InAs nanowires on an InAs (001) surface showing irregular, elongated morphology in SEM images (a,b); modeled by Monte Carlo simulations (c) and illustrated schematically (d).

APPLICATIONS

- Quantum computing and simulation.
- Error-resilient qubit implementations.
- Low-noise quantum logic and memory circuit.
- Scalable quantum networks based on nanowire arrays

DEVELOPMENT STAGE

The invention has been conceptually designed and theoretically validated, with initial fabrication of tapered nanowires confirming the feasibility of the proposed geometry. Proof of concept was demonstrated focusing on spectroscopic visualization of the electronic subband evolution along the tapered nanowires.

DIFFERENTIATION

- Scalable architecture suitable for integrated nanowire networks
- Single-gate operation
- Enhanced stability
- Self-tuning geometry
- Compatible with existing semiconductor-superconductor fabrication processes

REFERENCES

- Man Suk Song et al, Nano Lett., 2021