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Local User Project - 2022

Quantum View of a Superconductor-Semiconductor Junction

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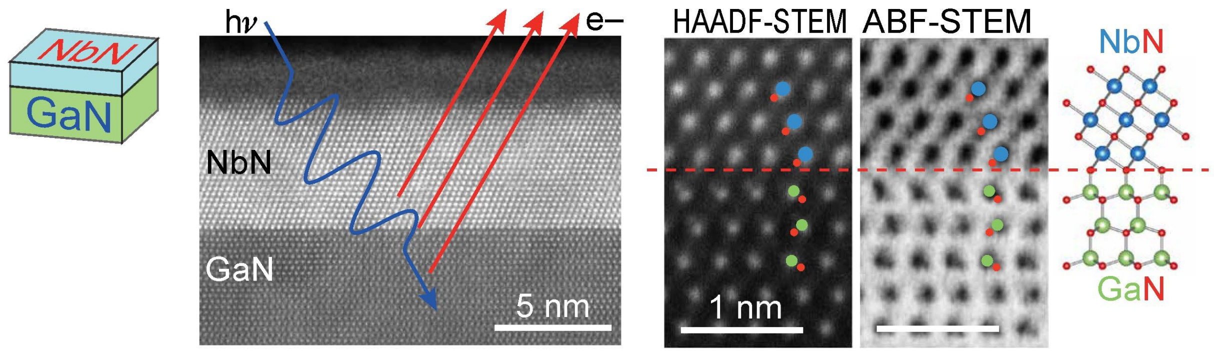
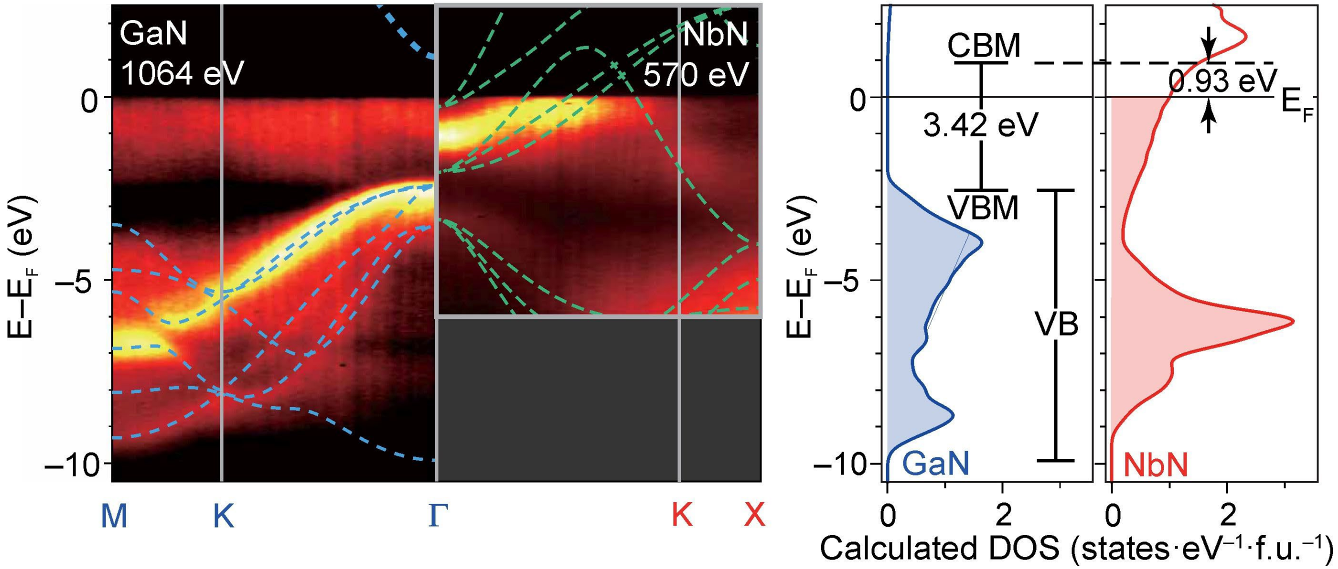
Currently, electronic device technology is based mainly on semiconductors. It first emerged in the middle on the 20th century and has improved ever since. Further technological advances including energy efficiency and information security might profit from exploiting quantum mechanical properties that are present in superconductors. The challenge is how to combine the two states and to make sure to get the best of both electrical worlds.

A collaboration of researchers from Cornell and the Paul Scherrer Institute (PSI) in Switzerland grew thin films of the superconductor niobium nitride (NbN) on top of gallium nitride (GaN), a semiconductor and vital component in many optical and power electronics. The team measured the electronic properties of the two materials directly at their interface using soft-X-ray angle-resolved photoelectron spectroscopy (ARPES).

PARADIM's electron microscopy and theory user facilities provided structural characterization and first-principles calculations of the two materials and the superconductor-semiconductor interface. The electronic states of NbN and GaN at the Fermi level remain separated, therefore revealing that the superconducting property of NbN is unchanged when interfaced with GaN. The new momentum-resolved understanding of the electronic properties right at the interfaces opens up new frontiers for quantum materials where subtle effects at the interfacial states play a defining role.





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