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【503】Electronic band structure of strained germanium: bridging theory with direct experimental evidence

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Planar Ge/SiGe heterostructures are integral to quantum technologies, particularly as platforms for quantum computation using hole-spin qubits. Compressive strain applied to germanium alters the energy dispersion of holes at the Γ-point, lifting the degeneracy between heavy and light holes by 130 meV. This results in two two-fold degenerate bands, characterized by effective spins $|j_z| = 3/2$ and $|j_z| = 1/2$. We confirm this energy diagram using soft X-ray ARPES, providing direct access to momentum-resolved energy levels. First-principles calculations quantitatively reproduce the experimental band structure and energy splittings, enhancing our understanding of the quantum functionality of Ge/SiGe heterostructures. Additionally, we explore the utility of soft X-ray ARPES in studying semiconductor/superconductor heterostructures, such as Al/Ge/SiGe.

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