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Atomically resolved local electronic structure of one-dimensional semiconductor nanotube junctions

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Semiconductor-semiconductor(S-S) junctions with different band gaps can be formed with carbon nanotubes (CNT) having different diameters connected smoothly by pentagon-heptagon pair defects. We report atomically resolved scanning tunneling microscopy (STM) and spectroscopy of the S-S CNT junctions. Different band gaps are exhibited on each side of the junction and a localized defect state within the band gap is clearly identified in the atomically resolved scanning tunneling spectroscopy (STS) image. The peaks of van Hove singularity on each side penetrate and decay into the other side across the junction over a distance of 2 nm. These experimental features are explained, with the help of tight binding calculation, by the presence of pentagon-heptagon defects at the junction.

