

【S-07】

The Novel Electronic Structure of One-Dimensional Chains on Si(111)-5×2-Au

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A one-dimensional chain of Si(111)-(5×2)-Au is explored using scanning tunneling microscopy (STM) and spectroscopy (STS). A chain of bright protrusions (BP) have a evanescent state in a gap, while a BP-free region is metallic. Surprisingly, the evanescent states are Gaussian, resulting in parabolic height variation of a chain, and self-scaled to each chain length, suggesting a chain length dependent harmonic potential as a possible interaction. Thus, a one-dimensional Si row on this surface is serially alternating chains of nanoscale metallic and semiconduction phases. This has an important implication for the ground state of one-dimensional metals, and may explained the unusual electronic structure of this surface.