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Metal-insulator transitions on Au atomic chains with two competing bands

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1D atomic chains on Au/Si(557) feature two proximal 1D bands near Fermi level, which were controversially attributed as a spinon-holon pair of Luttinger liquid. Angle-resolved photoemission show that only one band is metallic with the neighboring one gapped at room temperature. Furthermore, even the metallic branch is found to undergo a metal-insulator transition upon cooling, which follows a mean-field type behavior. Scanning tunneling microscopy observes two apparently unequivocal chains on the surface, one of which exhibits periodicity doubling accompanying the metal-insulator transition. The surface 1D structure is thus concluded to be insulating at low temperature with Peierls-type instability, denying the previous Luttinger-liquid idea. Interestingly, Au/Si(337) is also found to shows the metal-insulator transition with two competing bands observed on Au/Si(557). Scanning tunnelling microscopy imaging indicates that these surfaces possess common 1D atomic chain structures while the interchain distance is different. This explains the very similar electronic structure and transition of the two systems.