An STM Study of Atomic Co Wires

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Proposal Title: STS Study of One-Atom Wide Co Wires

Research Achievement:
Due to stronger electron-electron interactions, 1-D systems are predicted and, in some cases, have been shown to exhibit unique and exotic electronic properties. One route to the formation of 1-D systems is by self-assembly using low-index vicinal crystal surfaces. In this regard, we have successfully formed 1-atom wide Co wires using Cu(775), a 7-atom wide stepped array with (111) terraces. For our particular morphology, the Co wires are not laterally encapsulated but are positioned exactly at the step edge. We have performed STM studies of this system at room temperature (RT) and have made STS measurements at low temperature (LT), ~5K. While vicinal Cu(111) does exhibit

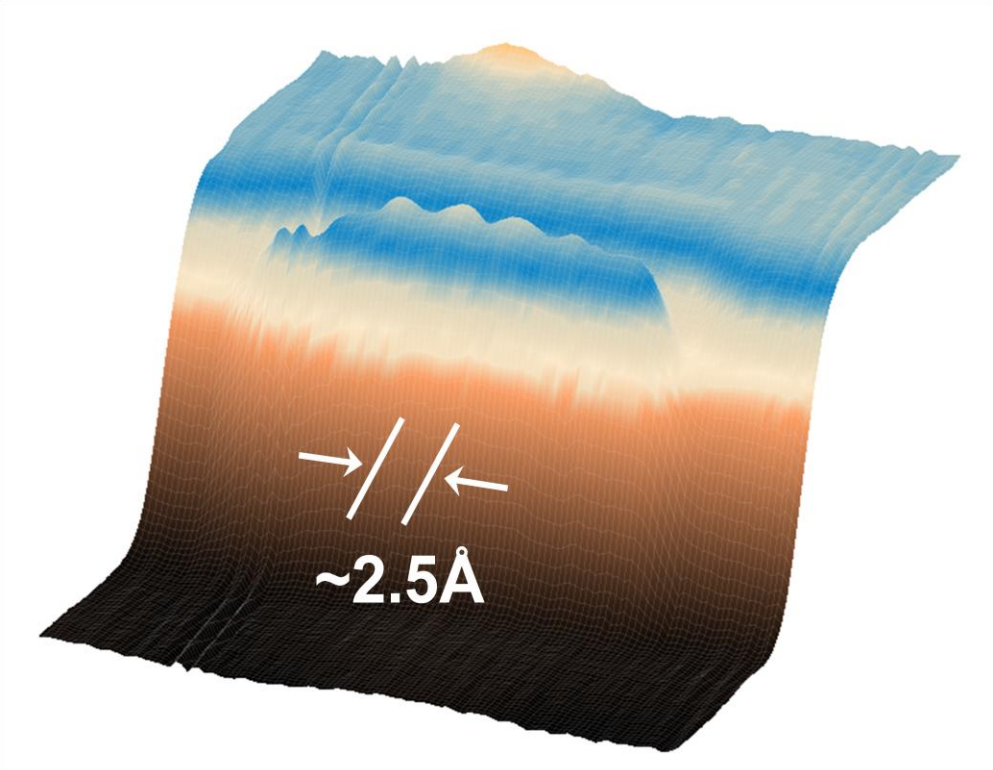

Figure 1: *A 7-atom Co chain that self-assembled at a Cu step edge. This image was obtained using a low-temperature STM at the Center for Functional Nanomaterials, Brookhaven National Labs.*

“frizz” at the steps when scanning above cryogenic temperatures, the Co wires pin the edges, visually accentuating their presence under STM. Furthermore, we observe a lower local density of states for the Co wires as compared with the Cu steps at RT, which also serves to differentiate the two metals. At LT, a Co chain at the step edge induces a Friedel-like oscillation (as shown in Fig.1) that is not present at a bare Cu step. Cu(111) possess a surface projected bandgap which may electronically decouple the wire electrons that reside in this gap. However, we also see resonances at the Fermi level which suggests electronic coupling between the vicinal Cu surface and the Co electrons.

Future Work:

We have obtained interesting scanning tunneling spectra and are currently trying to understand them more theoretically. To facilitate our understanding, we intend to perform more tunneling spectroscopy measurements to rule out tip effects and other sources of spectra variability. This would, for example, involve using a different type of tip, such as Pt-Ir, instead of W. Furthermore, we would like to attempt the spectral mapping of a Co chain region. This would add greatly to our limited point-based measurements that have been made so far.