Electronic Supplementary Material (ESI) for Nanoscale.


# Programmability of Nanowire Networks

A. T. Bellew,[a,b] A. P. Bell,[a,b] E. K. McCarthy,[a,b] J. A. Fairfield,[a,b] and J. J. Boland*[a,b]

[a] School of Chemistry, Trinity College Dublin, Dublin 2, Ireland.
[b] Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Trinity College Dublin, Dublin 2, Ireland.

## Supplementary Information

### S1 Characterisation of Ni nanowires

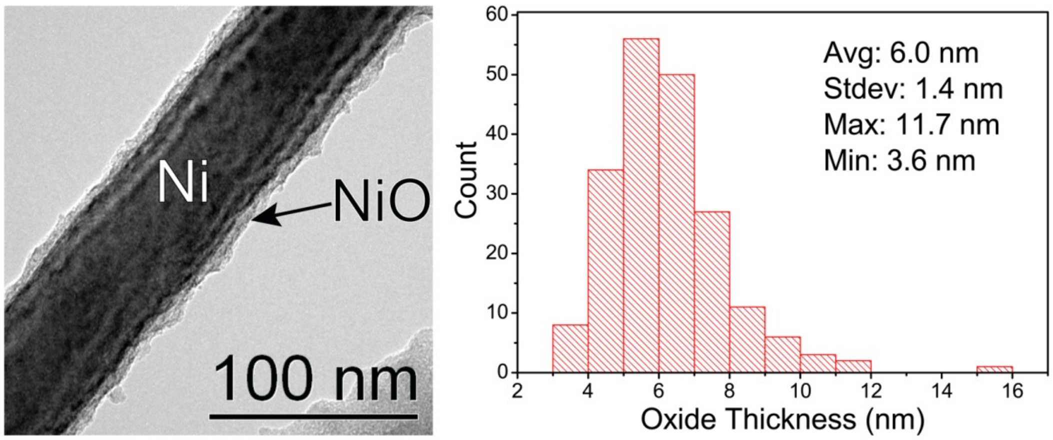


**Figure S1.1** Oxide thickness of Ni nanowires. (a) TEM micrograph shows clearly the Ni core and oxide shell structure of the nanowire. (b) Oxide thickness statistics shows an average thickness of 6 nm.

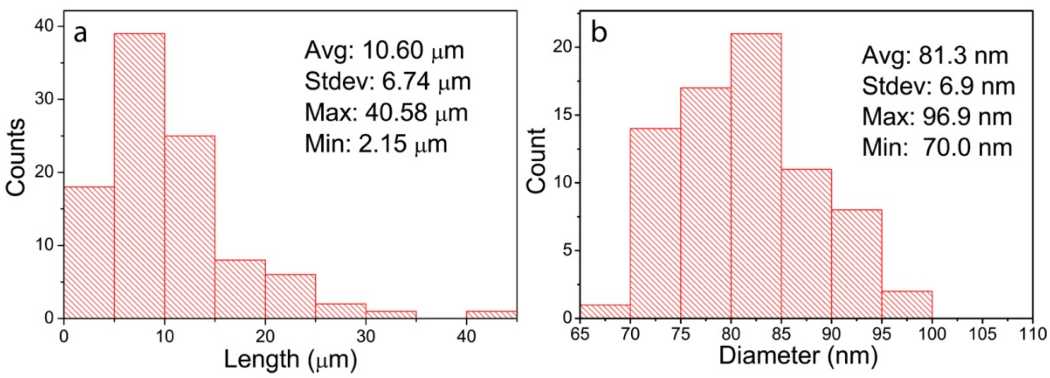


**Figure S1.2** Length and diameter statistics of Ni nanowires.

**S2 Forming Sweeps for Single Junction and Networks**

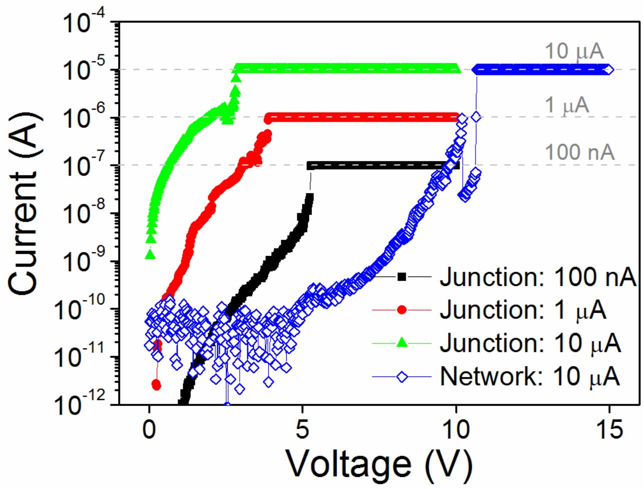


**Figure S2.1** Forming sweeps for the single junction and network data presented in Figure 2(a) of main text. Single junctions require multiple forming sweeps to prevent catastrophic breakdown. The compliance current for each subsequent sweep is set to 100 nA, 1 μA, and 10 μA respectively. The junction exhibits threshold switching until 10 μA is reached, where a non-volatile memory state is formed. We have found that networks do not require this gradual forming process, possibly due to the redundancy inherent to networks.

**S3 Visualisation of Activation Pathways**

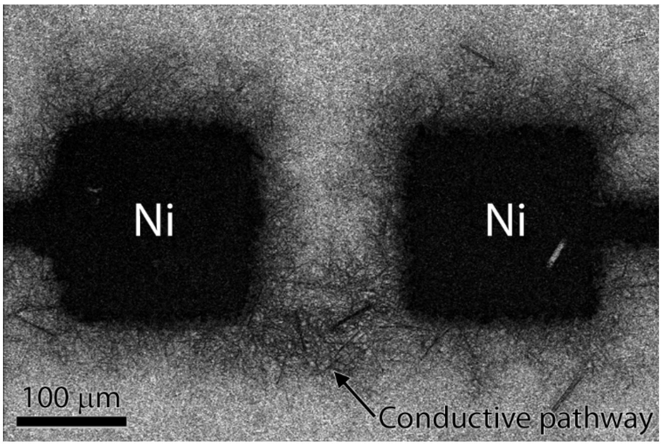

**Figure S3.1** Helium Ion Microscope (Zeiss Orion Plus) image of a Ni nanowire network ($D/L_{NW}$ = 9.43) post formation of the LRS. The left electrode was charged by supplying it with a high dose of $He^+$ ions. The positive charge prevents secondary electrons from escaping, thus the electrode shows up dark in the image. Due to the low resistance connection to the electrode, both the right electrode and the nanowire network conductive pathway also show strong contrast due to charging. This method is a very effective way of visualising the connectivity pathways of these random networks. Despite a practically infinite source of nanowires, the conductive path formed is highly selective, and excludes many junctions within the electrode area. We note that the activated network pathway extends from the corners of both electrodes, implying that electric field enhancement has a strong effect on network activation.