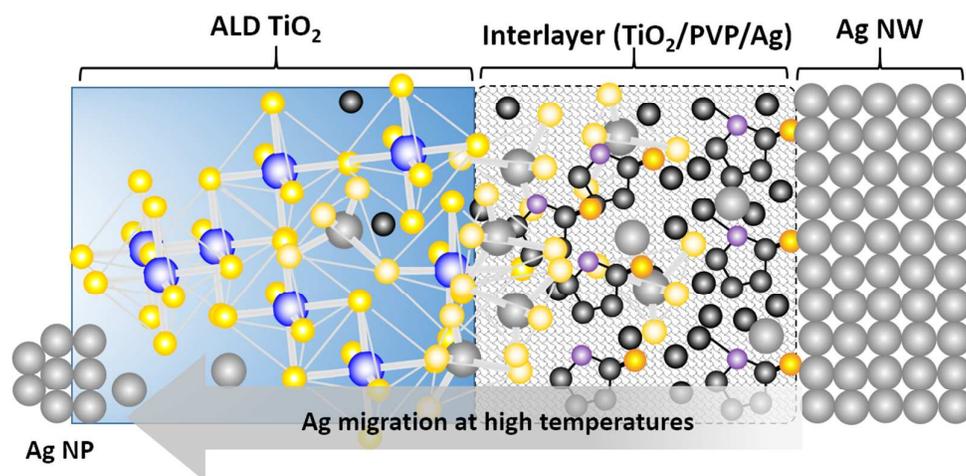


# Investigation of Ag-TiO<sub>2</sub> Interfacial Reaction of Highly Stable Ag Nanowire Transparent Conductive Film with Conformal TiO<sub>2</sub> Coating by Atomic Layer Deposition

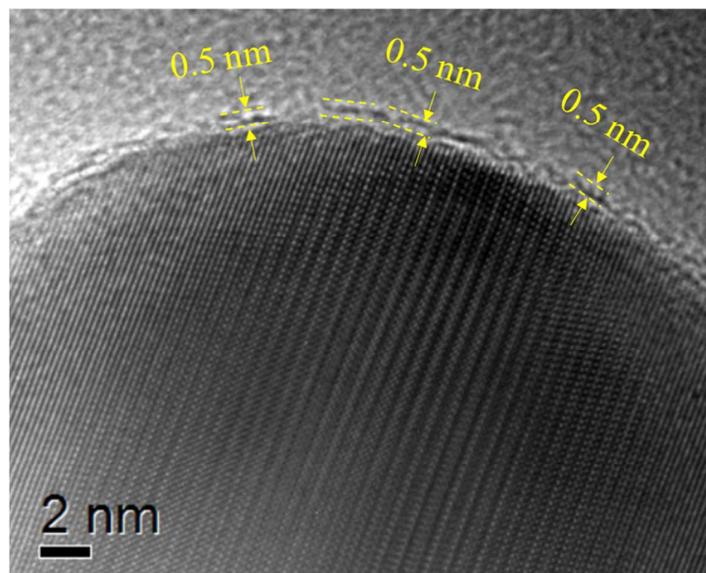
Ming-Hua Yeh,<sup>†</sup> Po-Hsun Chen,<sup>†</sup> Yi-Ching Yang,<sup>†</sup> Guan-Hong Chen,<sup>†</sup> and Hsueh-Shih Chen<sup>\*†</sup>

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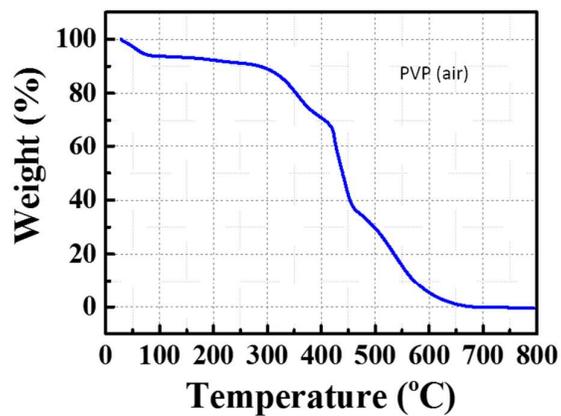
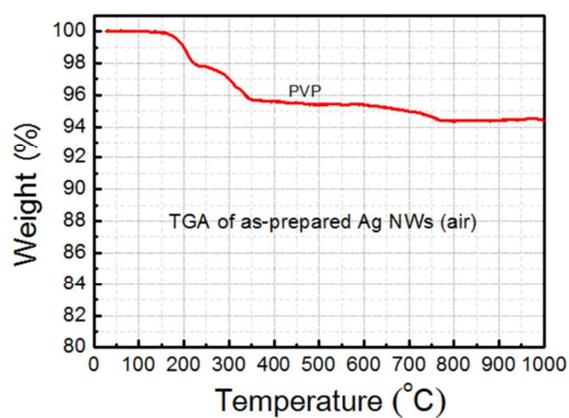
\* Corresponding author E-mail: [chenhs@mx.nthu.edu.tw](mailto:chenhs@mx.nthu.edu.tw)



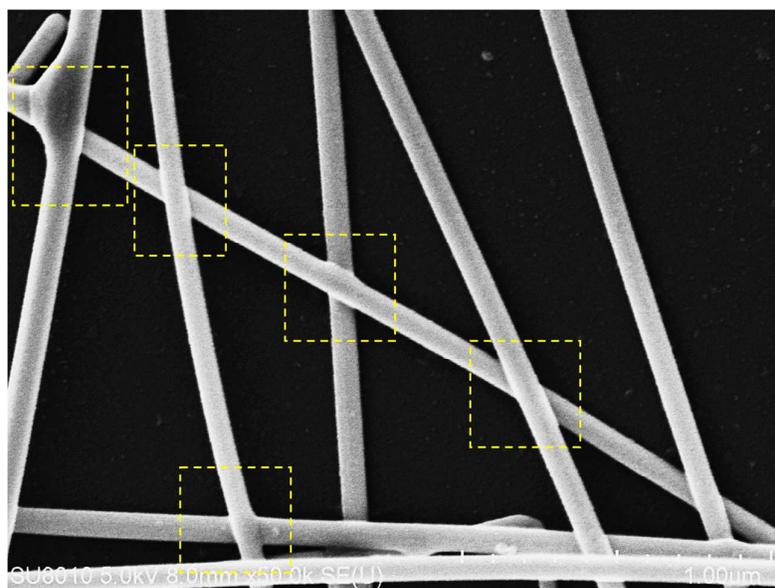
## Supporting Information



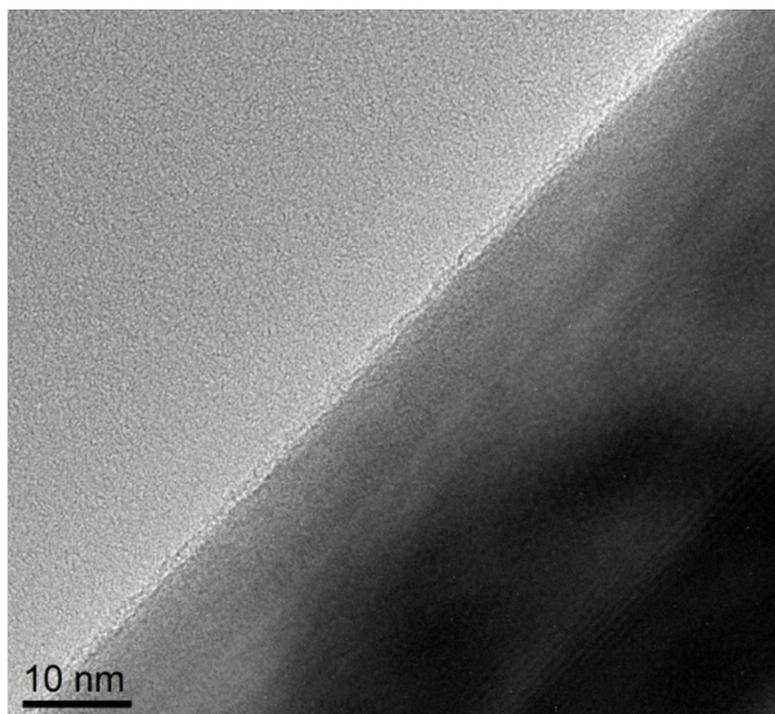
**Figure S1.** High resolution TEM image of a selected as-prepared Ag NW. The thickness of the PVP layer on Ag NW surface is estimated approximately 0.5 nm.



**Figure S2.** Thermogravimetric analysis (TGA) of as-prepared Ag NWs and PVP (air) in the current study.

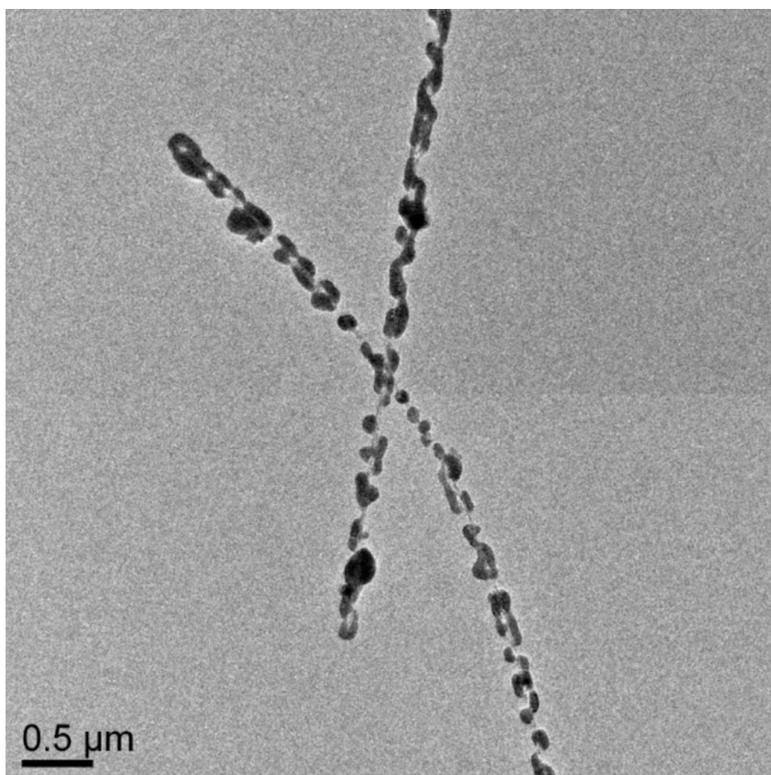


(a)

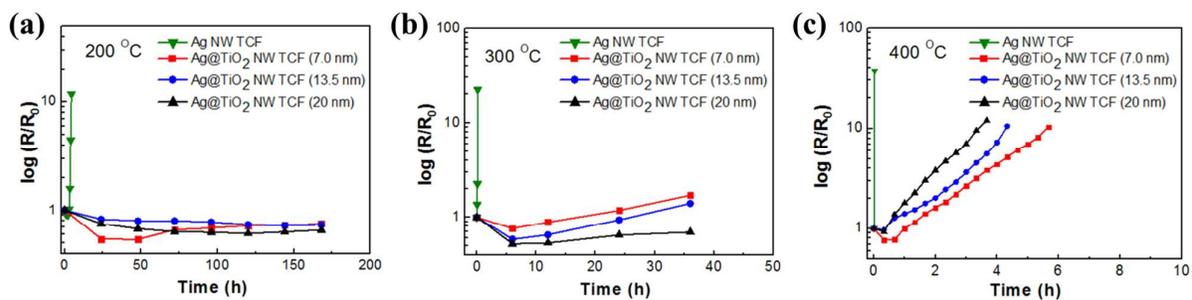


(b)

**Figure S3.** Ag NW TCF prepared by spin-coating followed by annealing at 200 °C for 30 min. (a) SEM image of the TCF. Sintering of Ag NWs are found at the interconnection contact points (yellow dashed squares). (b) TEM image of Ag NWs removed from the Ag NW TCF. A thin amorphous layer is observed in a selected region of a Ag NW.

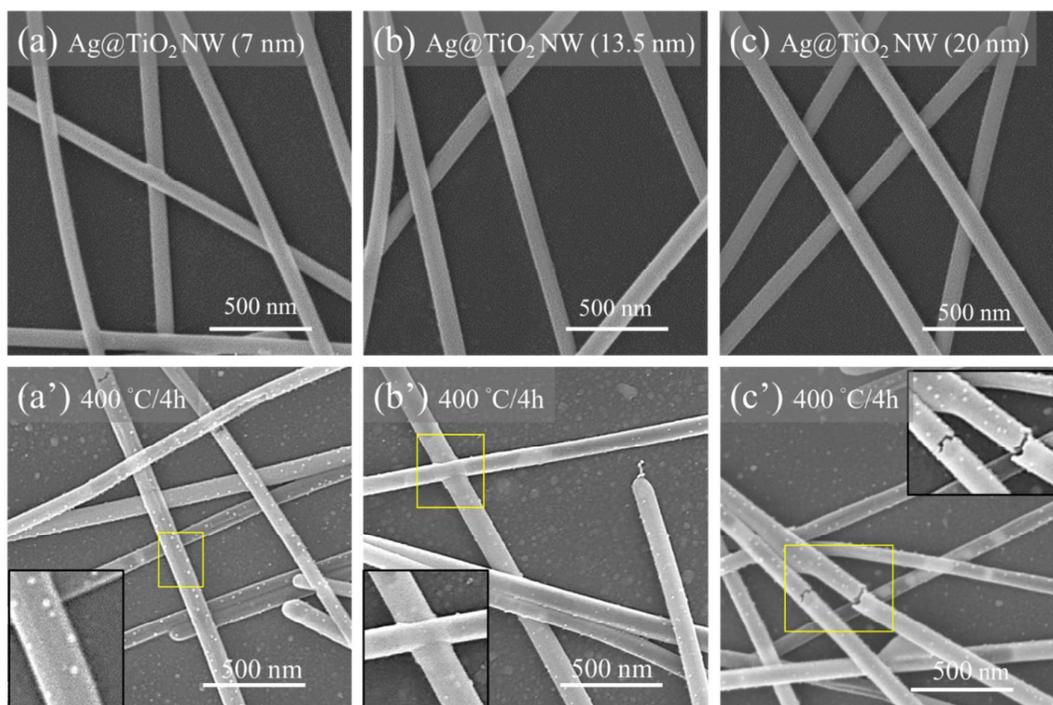


**Figure S4.** TEM image of Ag NWs after the ALD process with a longer  $\text{TiCl}_4$  pulse time.

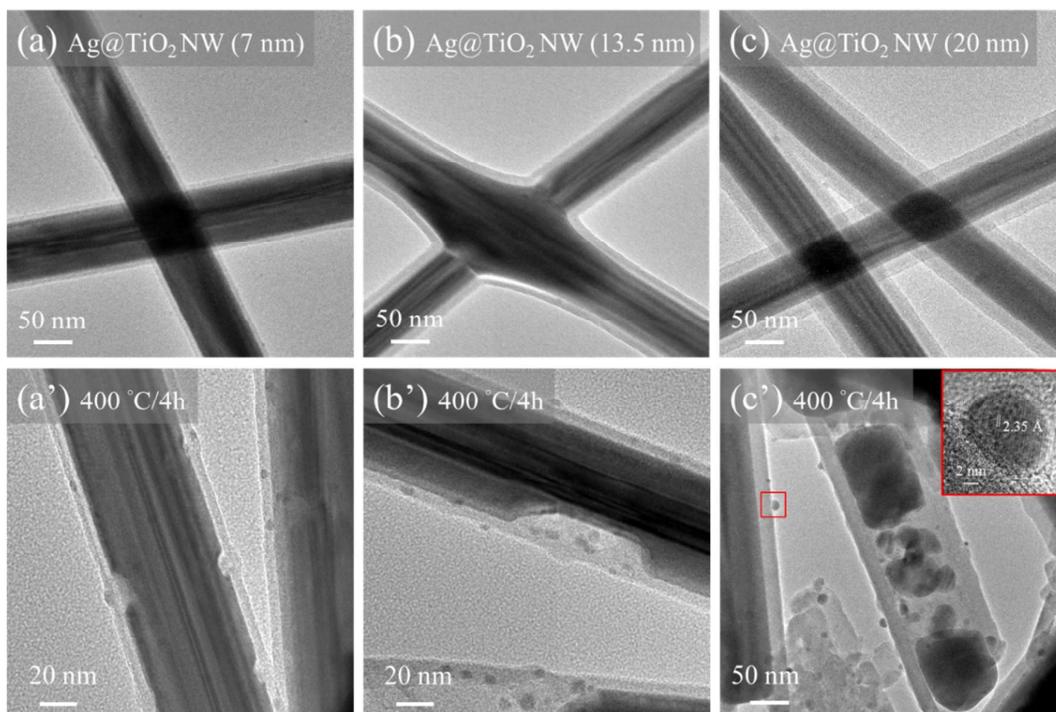


**Figure S5.** Variations of the sheet resistance of Ag@TiO<sub>2</sub> NW TCFs with different TiO<sub>2</sub> thicknesses aged at different temperatures, (a) 200 °C, (b) 300 °C, and (c) 400 °C.

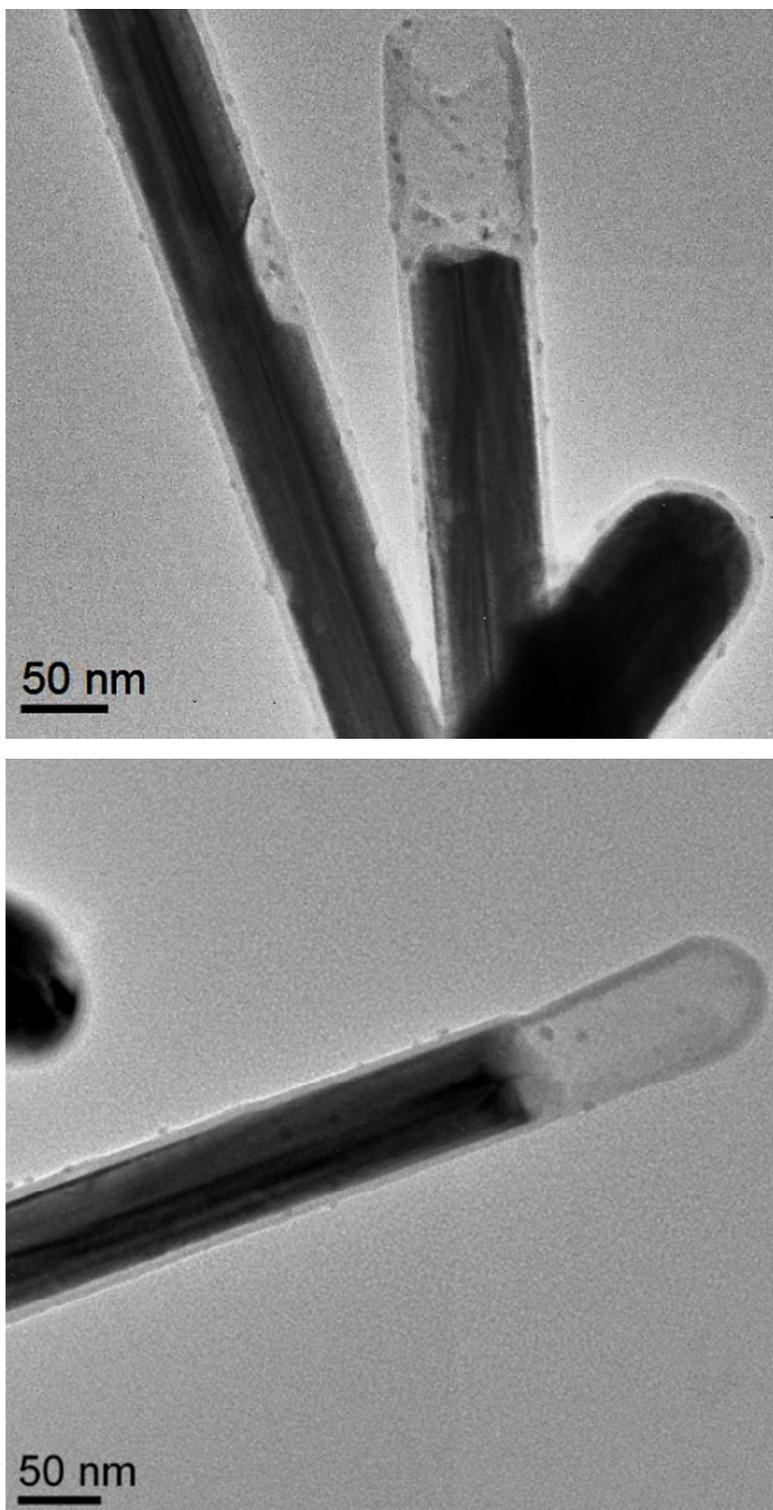
## Supporting Information



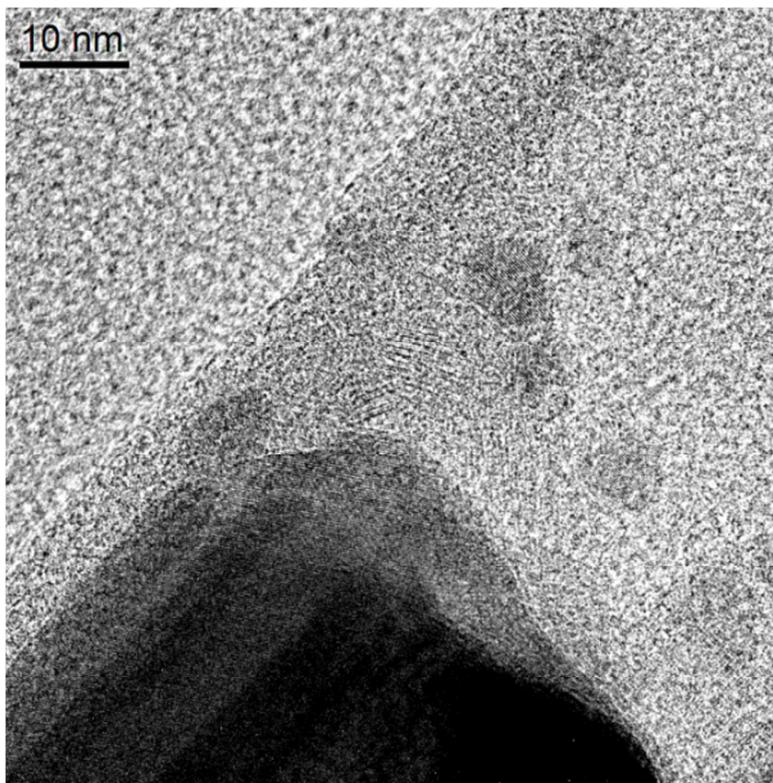
**Figure S6.** SEM images of Ag@TiO<sub>2</sub> NW TCFs before (a-c) and after (a'-c') aged at 400 °C for 4 h. The thickness of TiO<sub>2</sub> are (a and a') 7 nm, (b and b') 13.5 nm, and (c and c') 20 nm. The insets of a'-c' show enlarged images of the selected area.



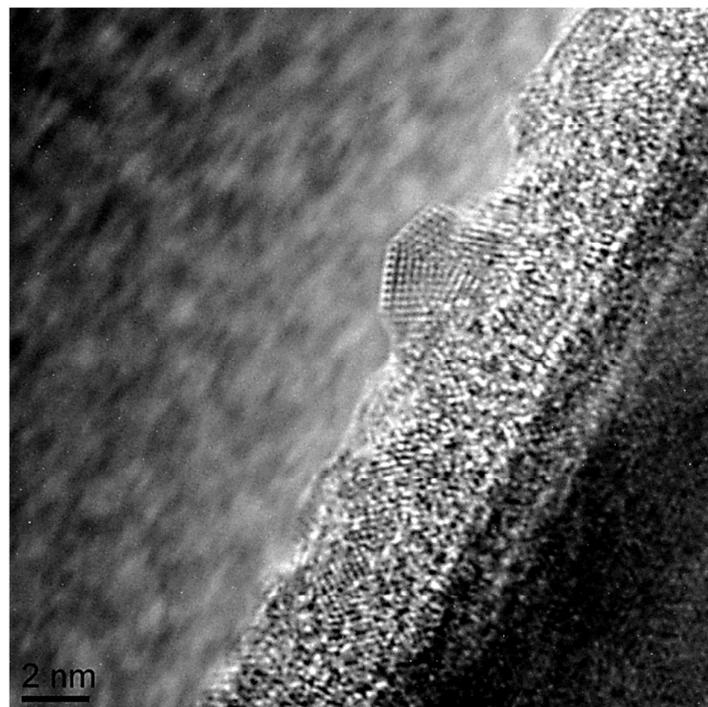
**Figure S7.** TEM images of Ag@TiO<sub>2</sub> NW TCFs before (a-c) and after (a'-c') aged at 400 °C for 4 h. The thickness of TiO<sub>2</sub> are (a and a') 7 nm, (b and b') 13.5 nm, and (c and c') 20 nm. The inset of c' show high resolution image of the selected area.



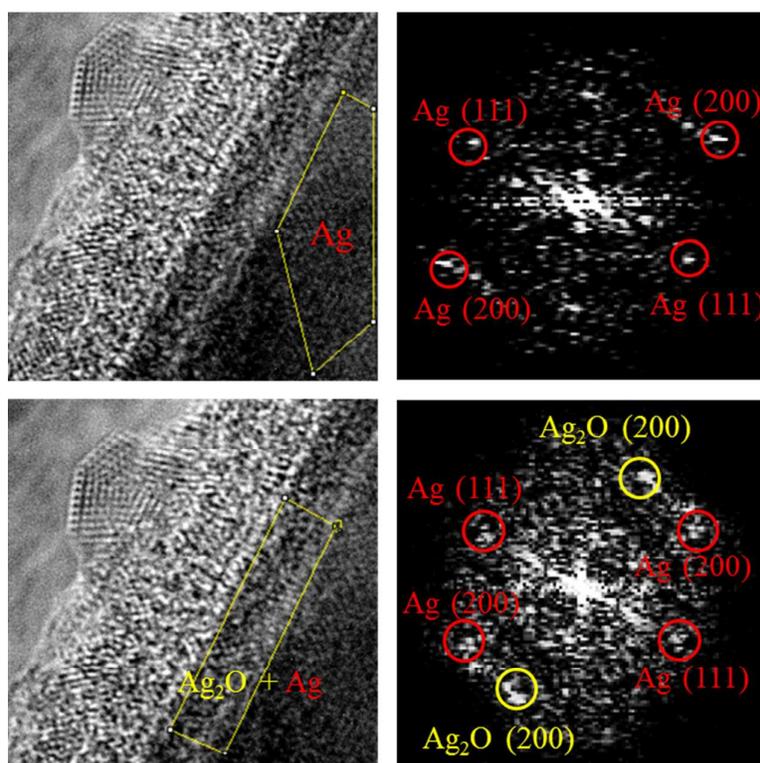
**Figure S8.** TEM image of 100-cycle ALD-TiO<sub>2</sub>-coated Ag NWs aged at 400 °C. The Ag NWs were removed from the aged Ag@TiO<sub>2</sub> NW TCF sample.



**Figure S9.** TEM image of an Ag NW TCF coated with 100-cycle ALD-TiO<sub>2</sub> annealed at 400 °C for 4 h.

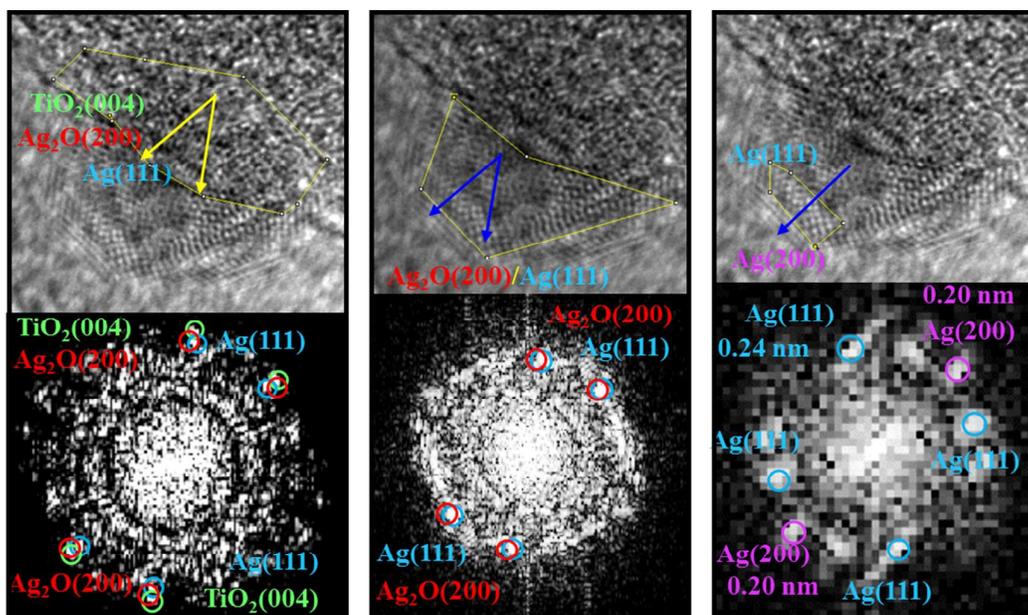
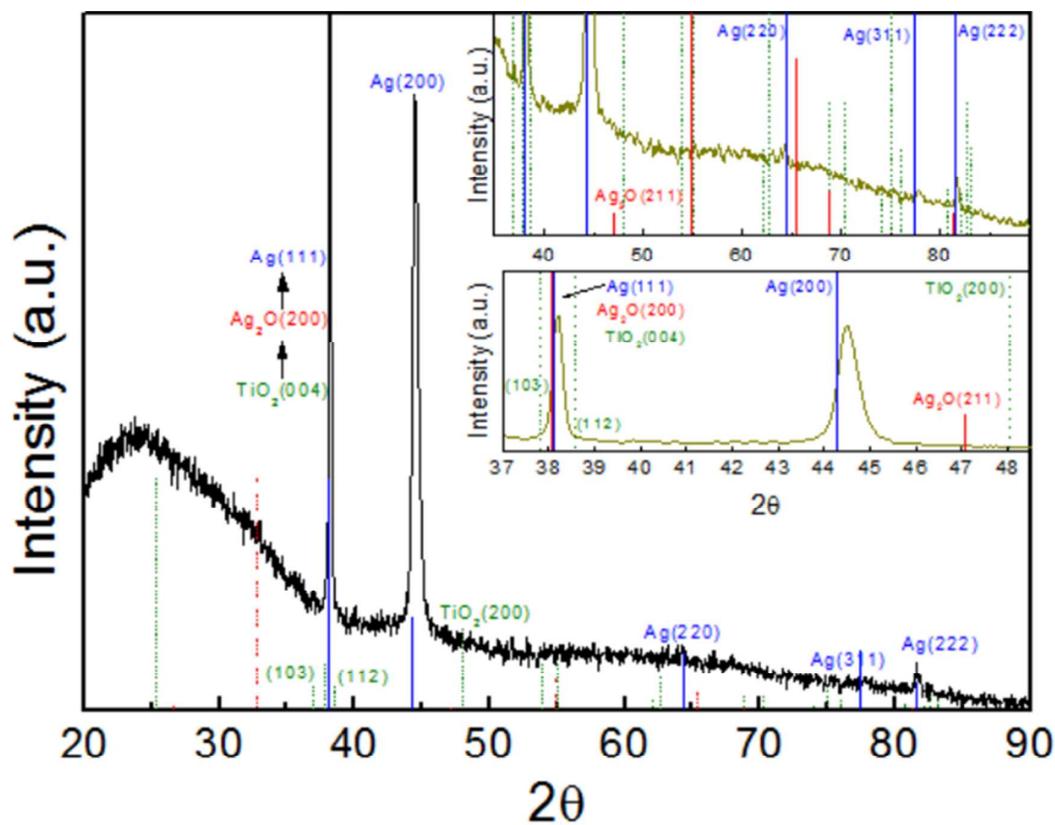


(a)



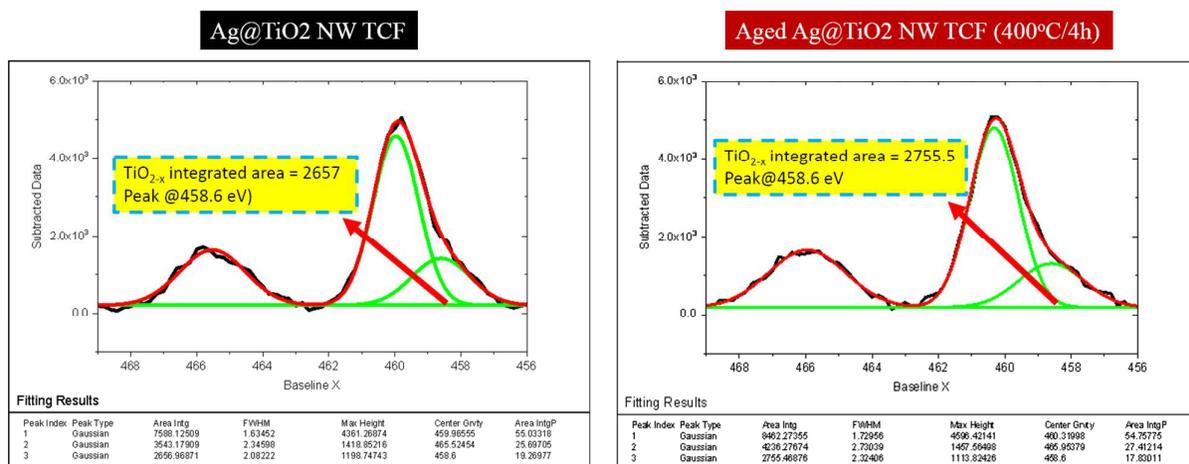
(b)

**Figure S10.** (a) TEM image of an Ag NW TCF coated with 100-cycle ALD-TiO<sub>2</sub> annealed at 400 °C for 4 h. (b) Selected area FFT analysis. The interlayer is composed of various phases including Ag<sub>2</sub>O and Ag.



**Figure S11.** XRD and high resolution TEM images/FFT analyses of Ag@TiO<sub>2</sub> NW TCF aged at 400 °C for 4h. The Ag (200) XRD peak shifts ( $\sim 0.2^\circ$ ) to a higher angle more than Ag (111), inferring existence of Ag<sub>2</sub>O (211) phase likely from the Ag nanoparticle formed after the aging process.

## Supporting Information



**Figure S12.** The Gaussian fitting of XPS Ti 2p peaks for Ag@TiO<sub>2</sub> NW TCF and aged Ag@TiO<sub>2</sub> NW TCF.