Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C

Electronic Supplementary Information

Cu^{n+}-Assisted Synthesis of Multi- and Single-phase Yttrium Oxide Nanosheets

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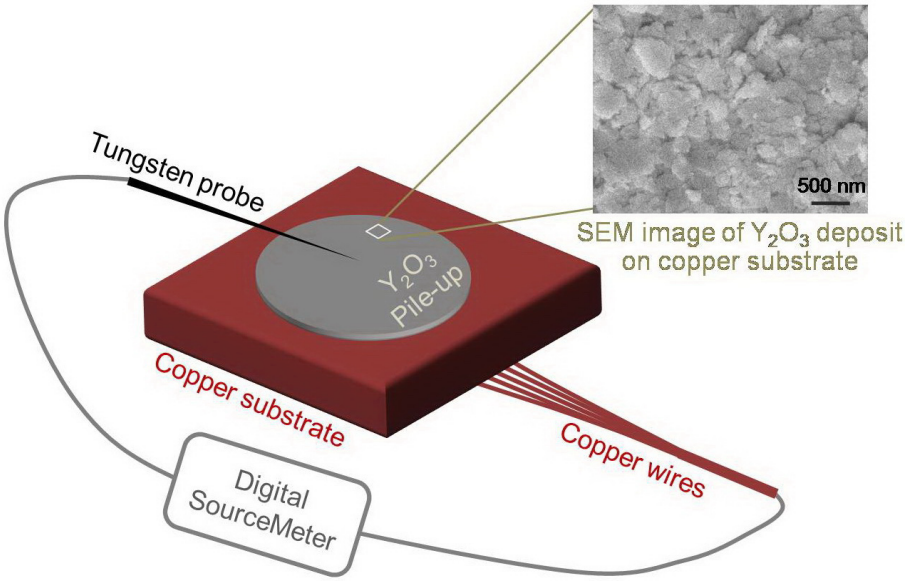

Fig. S1 Schematic of the I-V setup.

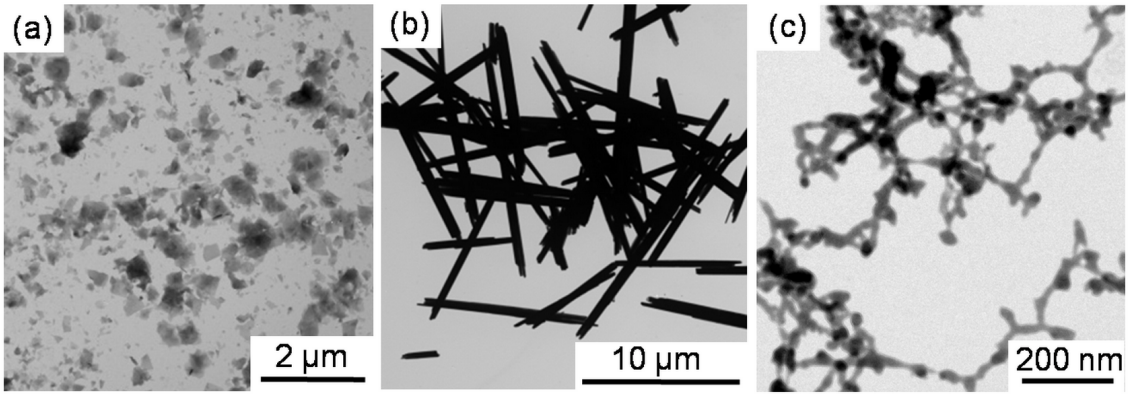

Fig. S2 TEM images of the irregular Y_2O_3 nanostructure (a) and the Y_2O_3 nanowire (NW, b) synthesized at 80 °C and 240 °C, respectively. (c) TEM image of the commercial Y_2O_3 powder.

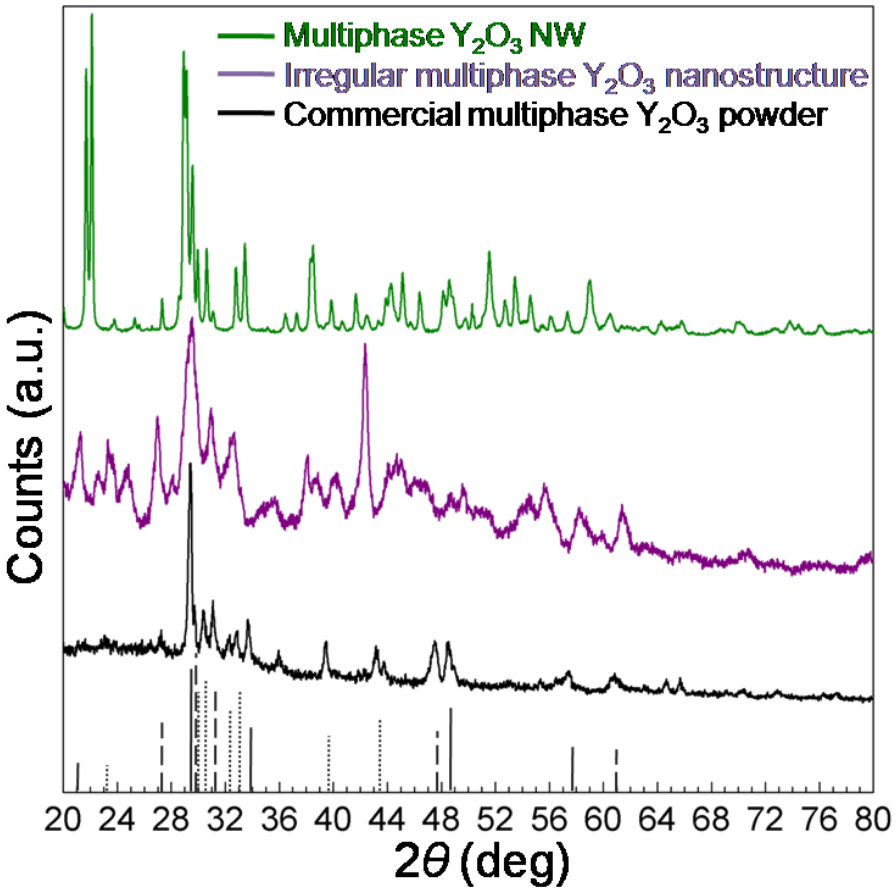

Fig. S3 XRD patterns of the commercial multiphase Y_2O_3 powder (bottom black pattern), the multiphase irregular Y_2O_3 nanostructure (middle purple pattern), and the multiphase Y_2O_3 NW (top green pattern). Three different phases present: cubic (labeled by solid line in JCPDS Files No. 41-1105), hexagonal (labeled by dashed line, JCPDS Files No. 20-1412), and monoclinic (labeled by dotted line, JCPDS Files No. 44-0399).

At high temperature (240 °C), Y_2O_3 NS dissolves into the solution gradually, leading to nucleation of yttrium hydroxide again.[1] The nuclei evolve into one-dimensional multiphase crystals at nanoscale due to the high anisotropic structure along c-axis in hexagonal yttrium hydroxide. Surface energy reduces substantially due to elimination of the rigid lamellar structured interface.[2] This prompts the thermodynamic driving force to fuse and align nanocrystals together anisotropically.[3] One-dimensional hydroxide NWs form spontaneously. On the basis of our present results, it is difficult to address the growth mechanism of the NW

quantitatively and kinetically. Further investigations are being carried out to reveal the growth dynamics.

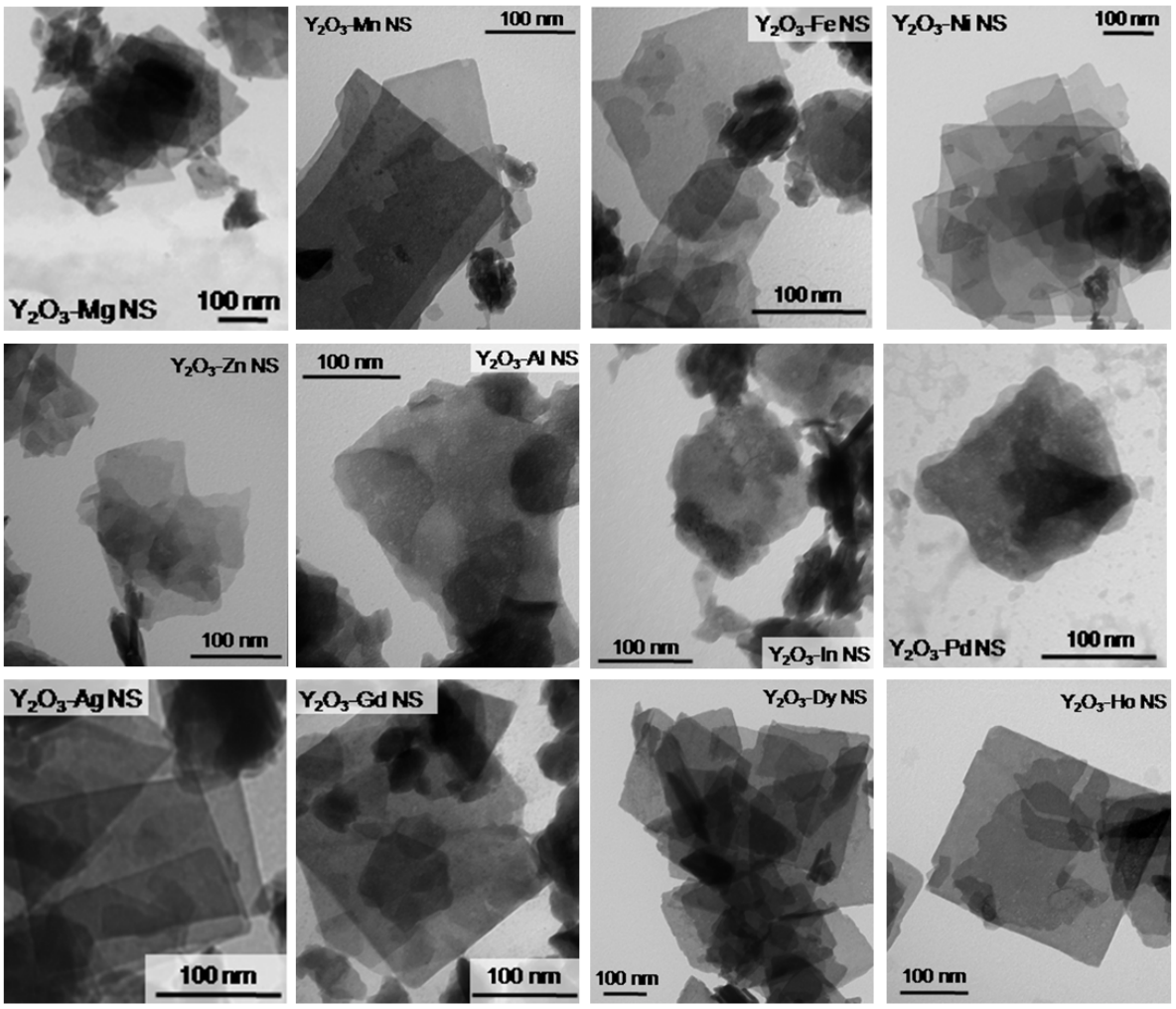

Fig. S4 TEM images of multiphase Y_2O_3 NS synthesized in the presences of the other metal ions.

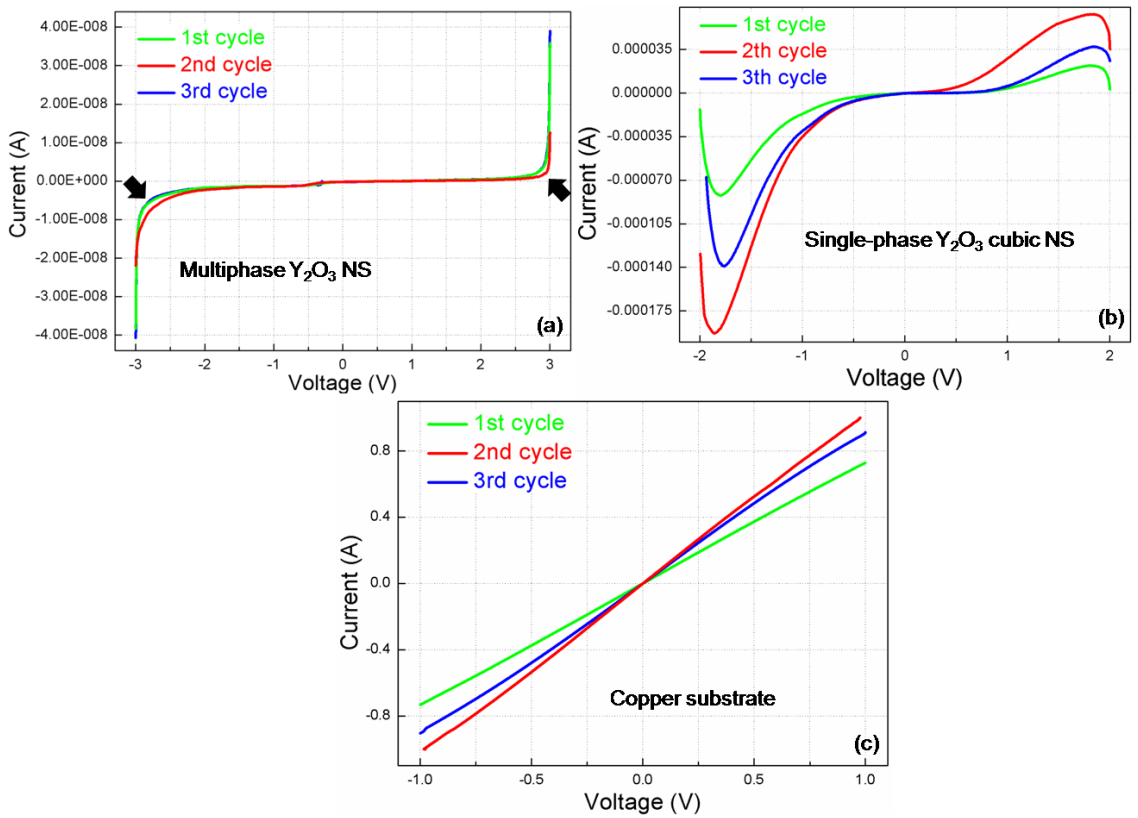

Fig. S5 First three I-V measurements of the multiphase Y_2O_3 NS (a), the single-phase cubic Y_2O_3-Cu NS (b), and the Cu substrate electrode (c).

The diode behavior and the negative-resistance performance are visible in our first three measurements. In Fig. S5a, the difference is observed in volt of -3 and -2 and 2.5 and 3 volts. In Fig. S5b, it shows more at -2 to -1 and 0.5 to 2 volts. In Fig. S5c, the slop of three plots is different. After examined all possible reasons, we believe that the difference is due to the unavoidable poor Ohmic contacts between the tungsten probe and the Y_2O_3 samples.

Supporting References

1. N. Li, K. Yanagisawa, N. Kumada, *Cryst. Growth Des.*, **9**, 2009, 978.
2. J. F. Banfield, S. A. Welch, H. Zhang, T. T. Ebert, R. L. Penn, *Science*, **289**, 2000, 751.
3. R. L. Penn, G. Oskam, T. J. Strathmann, P. C. Searson, A. T. Stone, D. R. Veblen, *J. Phys. Chem. B*, **105**, 2001, 2177.