Electronic Supplementary Material (ESI) for RSC Advances

Supporting Information

Coaxial Hetero-Nanostructures with Controllable Shell Thickness: A "Pore Widening" Method

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Table S1: A brief summary on reported synthesis of core-shell NWs and NTs in the literature.

Product	Synthesis method	Properties and Potential application	Ref.
p-i-n coaxial silicon NWs	Sequential vapour-liquid-solid (VLS) deposition	Photovoltaic device	[1]
$TiO_2/Ni(OH)_2$ or TiO_2/NiO core/shell NRs	TiO_2 NRs core: Hydrothermal $Ni(OH)_2$ or NiO shell: chemical bath deposition	Solar hydrogen generation and supercapacitor	[2]
$Co(OH)_2$ NF/ITO NWs	ITO NWs core: Chemical vapour deposition (CVD) $Co(OH)_2$ NFs shell: Potentiodynamic electrodeposition	Electrochemical capacitor	[3]
Co_3O_4 NW/NiO NF core-shell	Co_3O_4 NWs core: Hydrothermal NiO NFs shell: Chemical bath deposition	Electrochemical capacitor	[4]
BN-sheathed semiconductor NWs: ZnS/BN and Si-SiO_2/BN core-shell	Vapour-solid reaction process	Coat NWs with insulating sheath of BN	[5]
Cu_2S/Au core-shell NWs	Redox deposition method	Demonstrated synthesis method	[6]
Zn/ZnS nanocable	Thermal reduction/sulfidation	Demonstrated synthesis method	[7]
Ga-filled single-crystalline MgO NTs	CVD	Wide-temperature range nanothermometer	[8]

GaP/SiO_x, GaP/C and GaP/SiO_x/C coaxial nanocables	CVD	SiO_x shell reduced surface defects of GaP core NWs. C outer layer enhanced conductivity of NWs.	[9]
Ni NT encapsulated in CNT	Ni NTs grown within AAO followed by pyrolysis of C_2H_2 to form CNTs	Demonstrated synthesis method	[10]
PANI/Au core-shell NWs arrays	AAO template-assisted deposition followed by core-shrinkage	Demonstrated synthesis method	[11]
PPy/Au capped core-shell NWs and Au NTs arrays	AAO template-assisted deposition followed by pore-etching via NaOH	Demonstrated synthesis method. Au NTs showed a broad plasmon resonance at ~700 nm. PPy/Au capped core-shell NWs showed a second extinction peak near 550 nm.	[12]
Pd/Pt core-shell NW arrays	AAO template-assisted deposition followed by coating of Pt shell via magnetron sputtering after removal of template using NaOH	Highly effective electrocatalyst for electrooxidation of methanol	[13]
Ni/Au core-shell NWs	AAO template-assisted deposition of Ni core followed by coating of Au shell by electroless-plating after removal of template using NaOH	Ni/Au core-shell NWs functionalized with streptavidin-fluorescent dyes were studied for toxicological effects on pancreatic cancer cells	[14]
Mineral oil/(PVP-aTiO_2) core-shell and Anatase TiO_2 NTs	Electrospinning from a coaxial jet. TiO_2 NTs were obtained after removal of mineral oil core and calcinations	Demonstrated synthesis method	[15]
SiO_2 NTs and Au/SiO_2 core-shell NWs	SiO_2 NTs prepared using AAO template-assisted sol-gel deposition, followed by electrodeposition of Au into the NTs	SiO_2-insulated Au NWs (Au/SiO_2) showed high-quality dielectric properties	[16]
ZnO/Al_2O_3 core-shell NFs and Al_2O_3 NTs	Al_2O_3 were deposited onto ZnO NWs template via atomic layer deposition (ALD). Removal of ZnO core gave Al_2O_3 NTs	Demonstrated synthesis method	[17]
Bi/Bi_2O_3 core-shell NWs and Bi_2O_3 NTs	AAO template-assisted electrodeposition followed by slow thermal oxidation. Bi_2O_3 NTs obtained via fast thermal oxidation of Bi/Bi_2O_3 core-shell NWs	Demonstrated synthesis method	[18]
PPy/ZnS core-shell NWs	AAO template-assisted deposition of ZnS NTs via MOCVD followed by electrodeposition of PPy core within the ZnS NTs.	Observed positive shifts in the redox potentials of PPy and rectification behaviour due to electron transfer between ZnS shell and PPy core.	[19]
ZnO:Cl/ZnS core-shell NWs	ZnO:Cl NWs were electrochemically grown onto FTO electrode. ZnS shell was formed via successive ionic layer adsorption and reaction (SILAR) method.	ZnO:Cl/ZnS core-shell NWs showed photocurrent enhancement compared to ZnO:Cl NWs	[20]

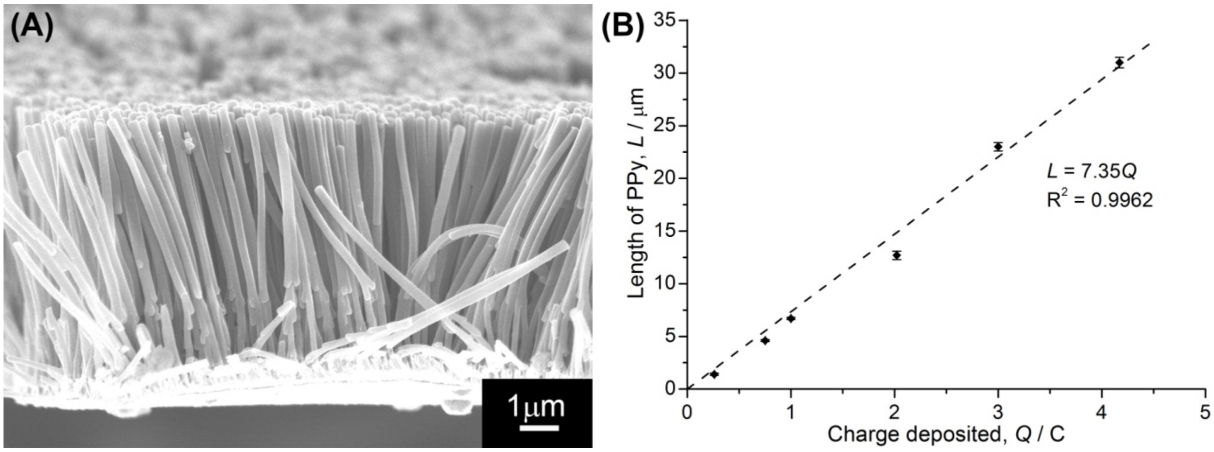

Fig. S1: (A) SEM image of as-deposited PPy NWs array, and (B) calibration plot of length of PPy NWs obtained as a function of charge deposited.

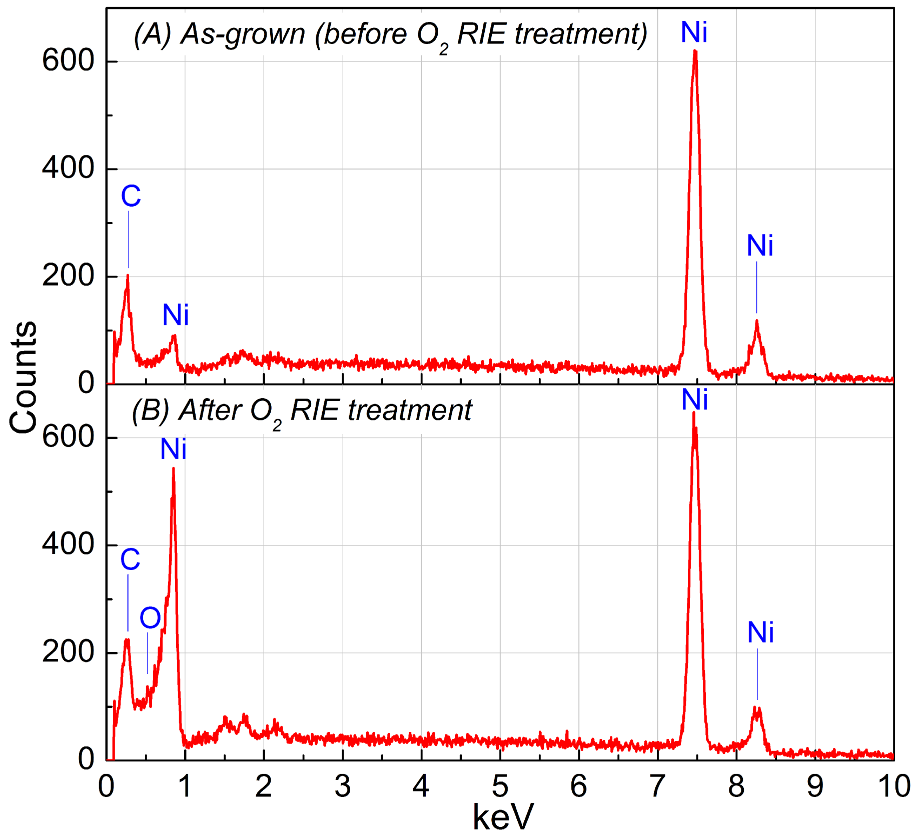

Fig. S2: EDX spectra of PPy/Ni core-shell NWs array (A) before and (B) after oxygen reactive ion etching (O_2 RIE) treatment. Only slight increase in oxygen content was detected for sample after O_2 RIE treatment in (B).

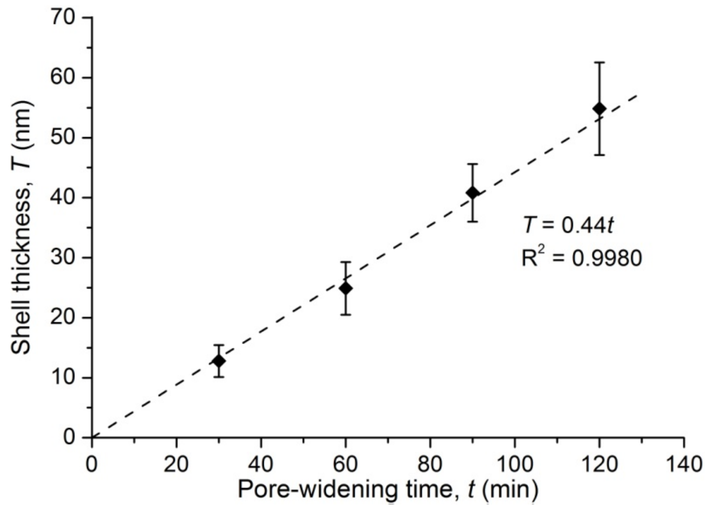

Fig. S3: Calibration plot of Ni shell thickness obtained as a function of pore-widening time.

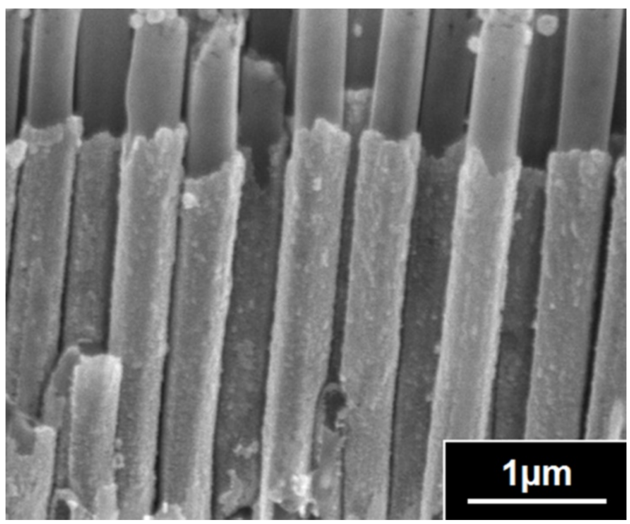

Fig. S4: Side view SEM image of PPy/Cu core-shell NWs array prepared by "Pore Widening" method.

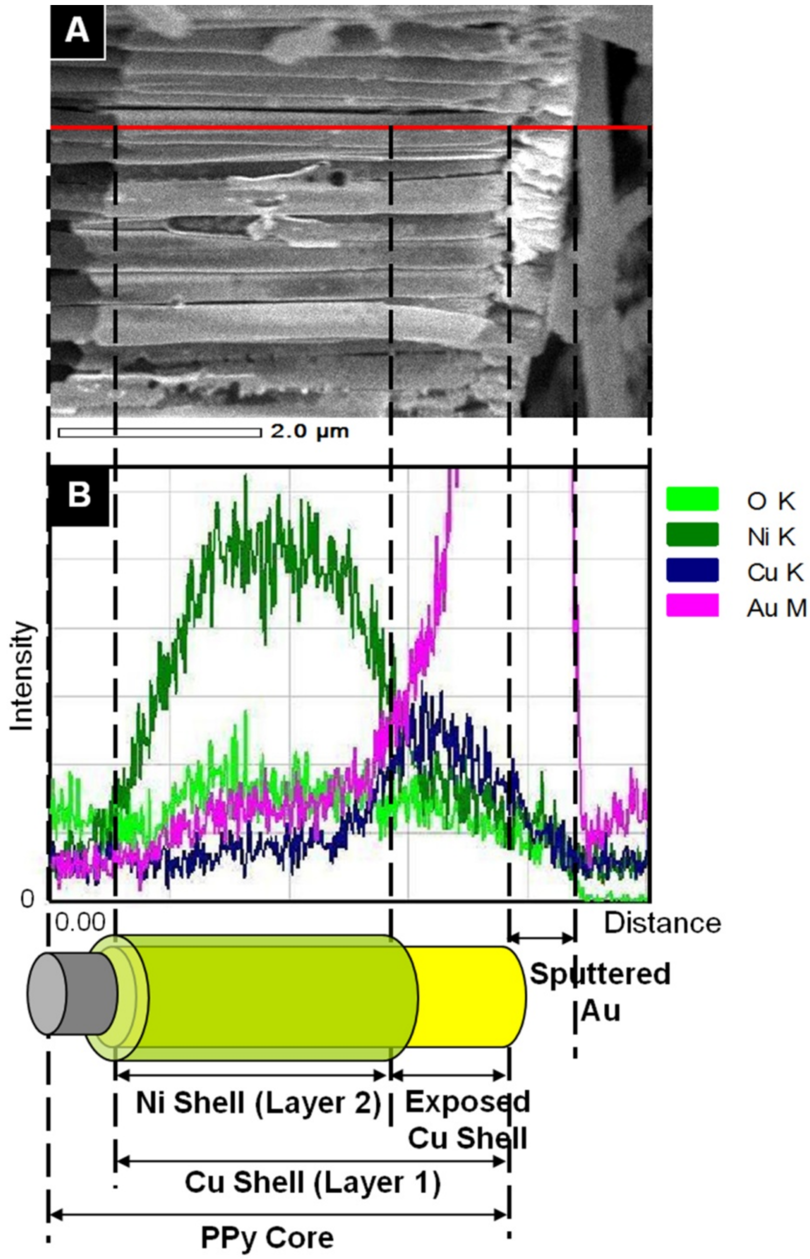

Fig. S5: EDX line analysis of tri-layered NWs: (A) SEM image of the PPy/Cu/Ni tri-layered core-shell NWs array. (B) The compositional line profiles probed by EDX along the red line in (A), showing well-correlated Ni and Cu signals along the NW axis.

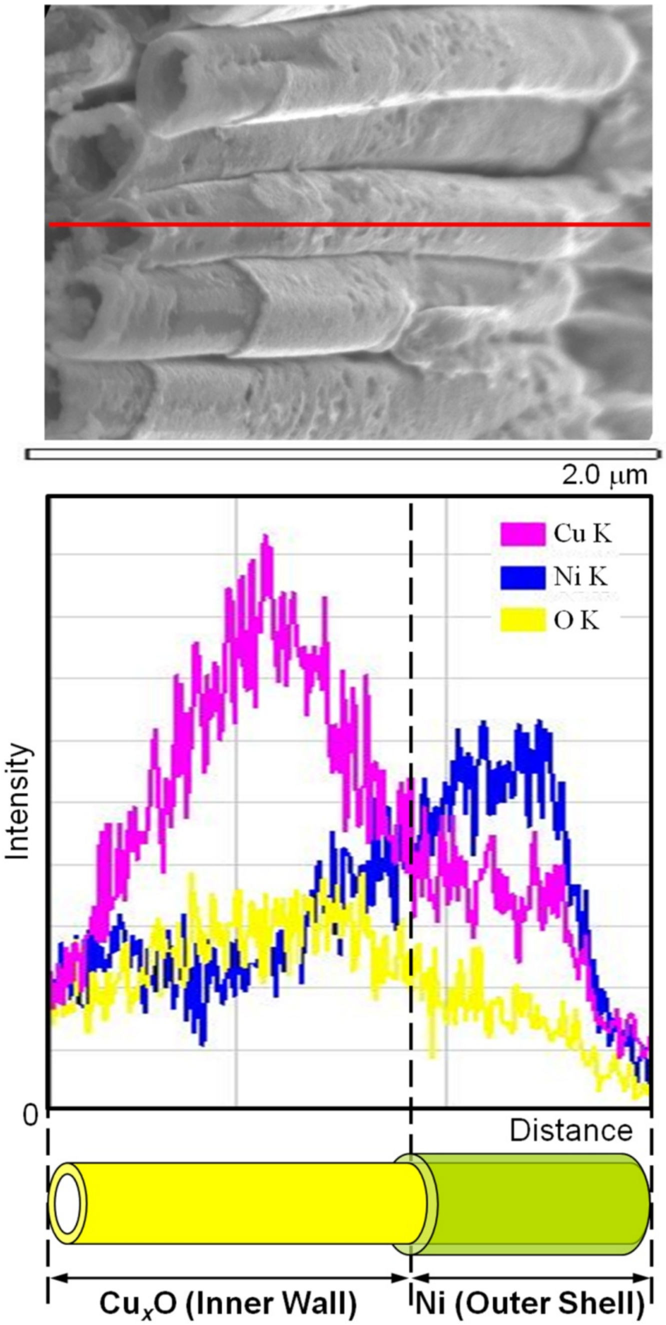

Fig. S6: EDX line analysis of the Cu$_x$O/Ni DWNT, indicating a fairly uniform distribution of the metal and oxide.

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