Supporting Information

For

Morphology Dependent Oxygen Reduction Activity of Titanium Carbide: Bulk vs. Nanowires

Vankayala Kiran,[a] *Srinivasu Kancharlapalli,*[b] *and Srinivasan Sampath*[a,*]

Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore -560012

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STEM-EDS mapping of TiC-NW

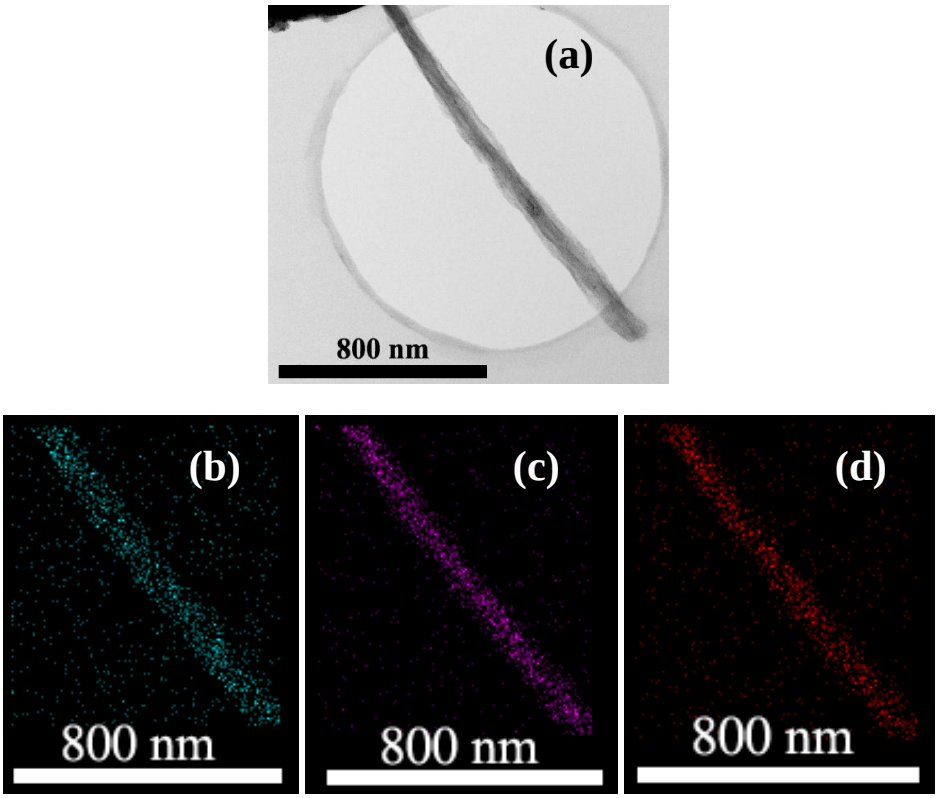

Figure S1. STEM (a) B F image of TiC-NW and corresponding X-ray maps (b) C-map, (c) Ti-map and (d) O- map.

Electrical properties of TiC-NW

To depict the electrical properties, preliminary studies are carried out on as-obtained TiC-NW. Devices are fabricated on Si/SiO_2 substrate using dielectrophoresis. Device was fabricated as follows. Pre-defined patterns are fabricated onto pre cleaned Si/SiO_2 substrates using optical lithography with Au (50nm) as contact material deposited on selective regions using RF sputtering, followed by lift-off procedure. Individual and well-separated TiC-NW dispersed in dichloro ethane are aligned in respective regions using AC dielectrophoresis with V_{p-p} of 10 V and a frequency of 5 MHz. AC dielectrophoresis result in the alignment of TiC-NW between fingers of the device (figure S2). *I-V* characteristics represent a linear response to voltage suggesting typical ohmic behaviour (figure S3). Effect of gate voltage on *I-V* characteristics of TiC-NW displayed no effect of gating, suggesting metallic nature of TiC-NW.

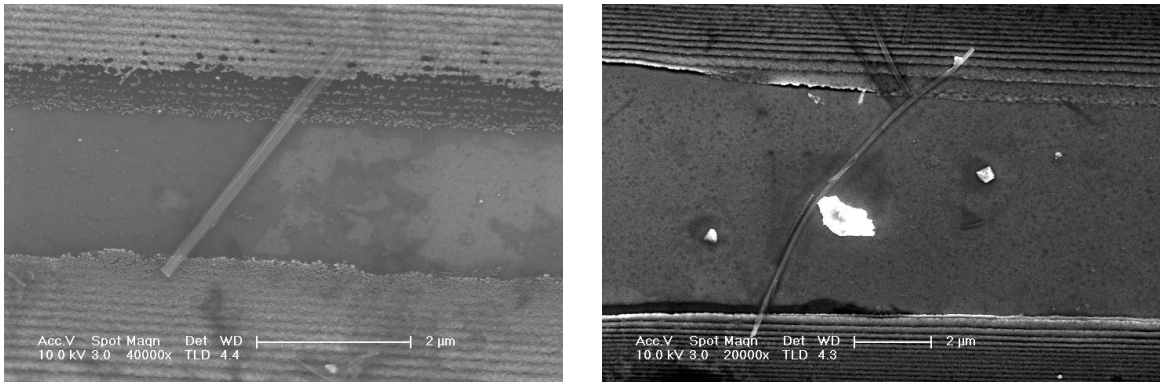

Figure S2. SEM images of TiC-NW based device after dielectrophoresis

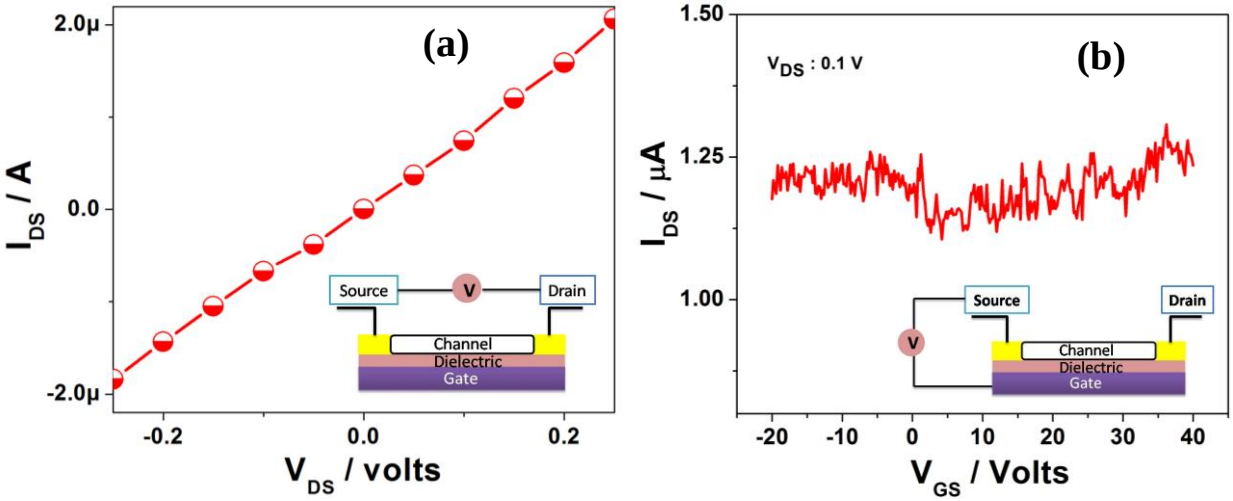

Figure S3. I-V characteristics of TiC-NW based device. (a) Plot of I_{DS}-V_{DS} at V_{GS}= 0 V; (b) plot of I_{DS}-V_{GS} at V_{DS}= 0.1 V. (DS represents source-drain and GS represents gate-source). Inset shows configuration of the device used.

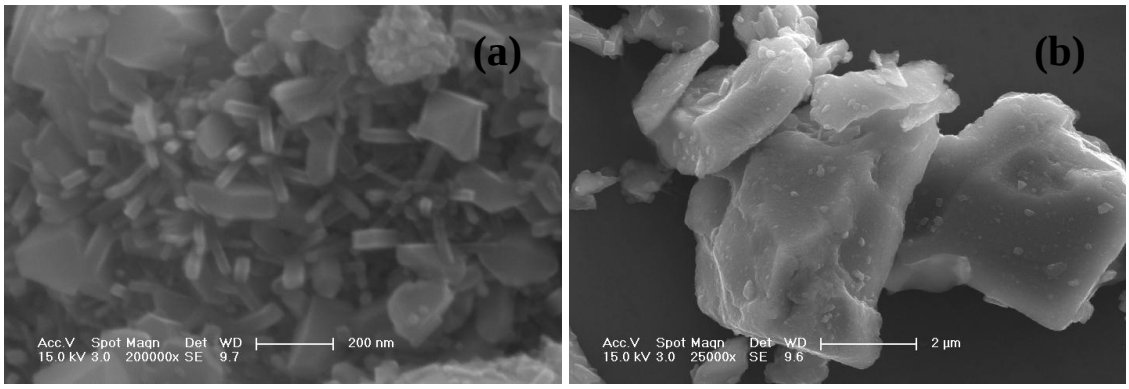

Figure S4. SEM images of hydrothermally treated TiC in (a) 0.5 M HCl and (b) NaCl (pH~7)

N_2 adsorption-desorption isotherms

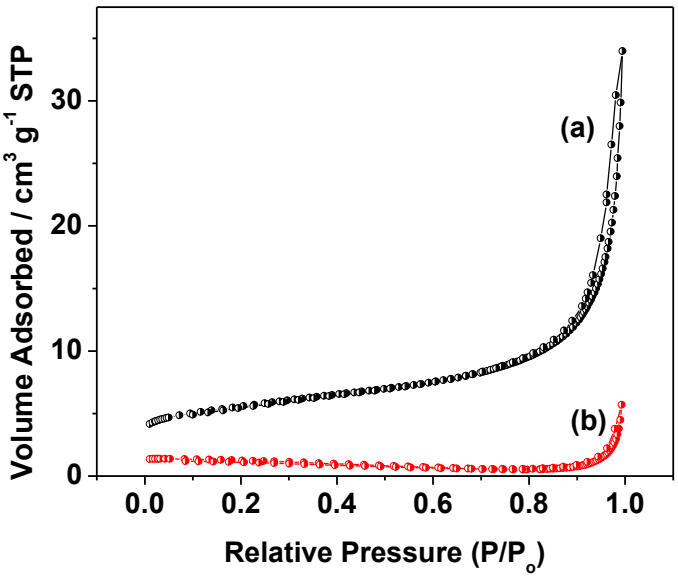

Figure S5. Nitrogen adsorption-desorption isotherms corresponding to (a) TiC-NW and (b) bulk TiC particles

Deconvoluted O-1s spectrum of TiC-NW

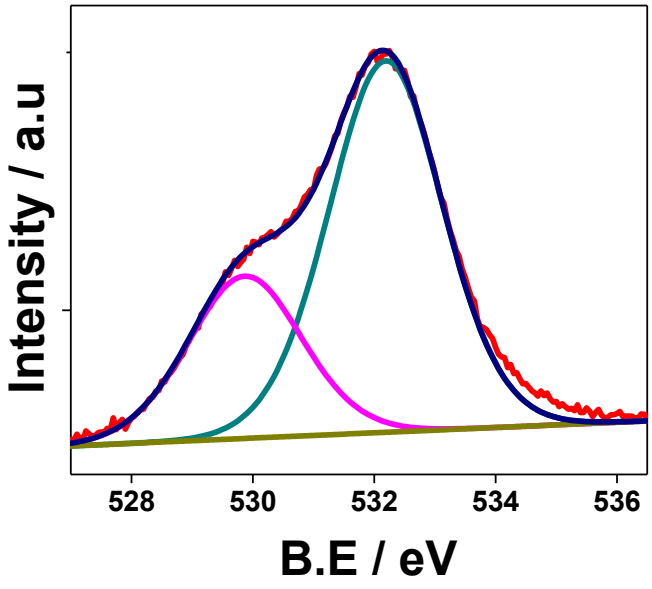

Figure S6. Deconvoluted O-1s spectrum of TiC-NW

The deconvoluted O-1s region of TiC-NW shown in figure S5 consists of two peaks located at binding energy (B.E) values 529.9 eV and 532.2 eV. The appearance of former peak reveals the presence of titanium oxides [1,2] whereas the latter peak is attributed to the

presence of adsorbed water.[2] It has been reported that the latter peak can be eliminated by Ar^+ ion etching.

Raman spectrum of TiC-NW

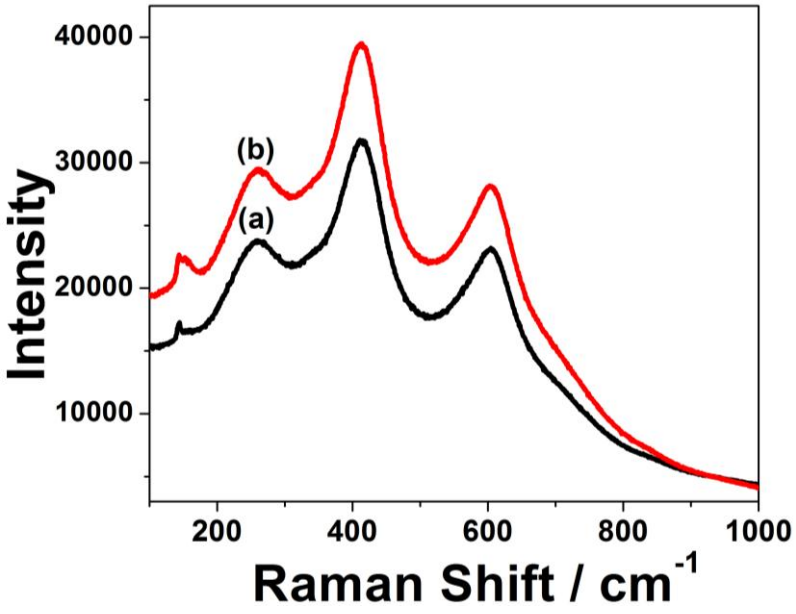

Figure S7. Raman spectra of (a) bulk TiC particles and (b) 1D TiC-NW

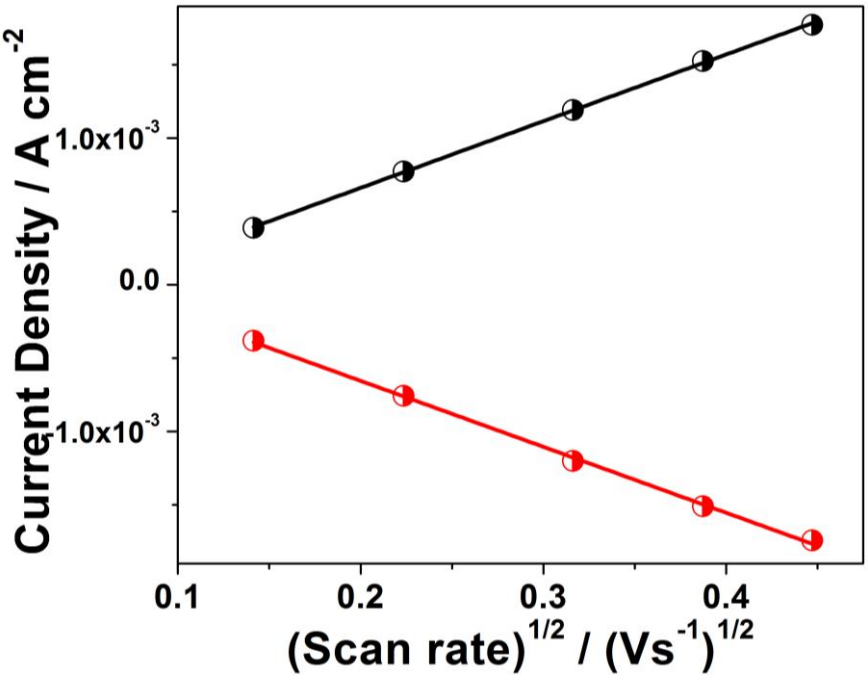

Figure S8. Variation of forward (black) and reverse (red) currents as a function of square root of scan rate using TiC-NW. Electrolyte used is 0.001 M $[Ru(NH_3)_6]^{3+}$ in 0.5 M phosphate buffer (pH~7)

Effect of loading of TiC-NW on ORR

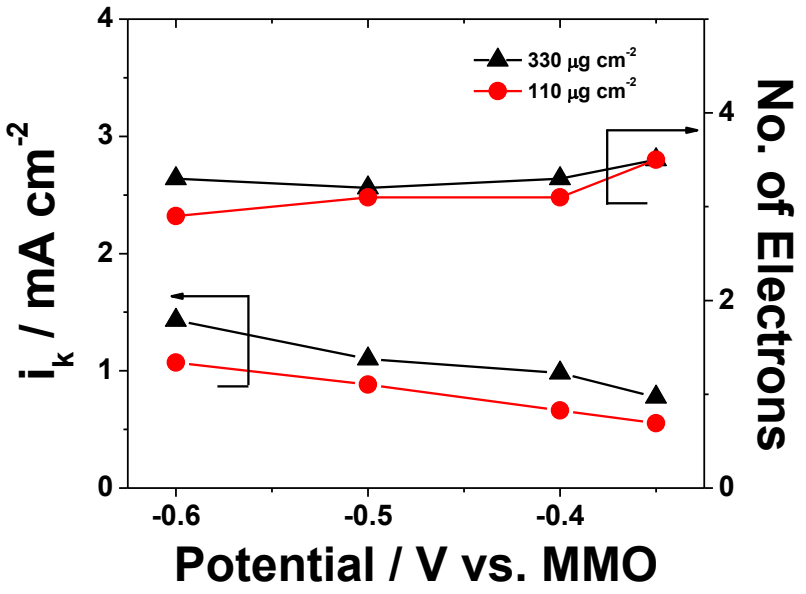

Figure S9. Effect of loading on kinetic current density and number electrons transferred during ORR on TiC-NW modified electrode.

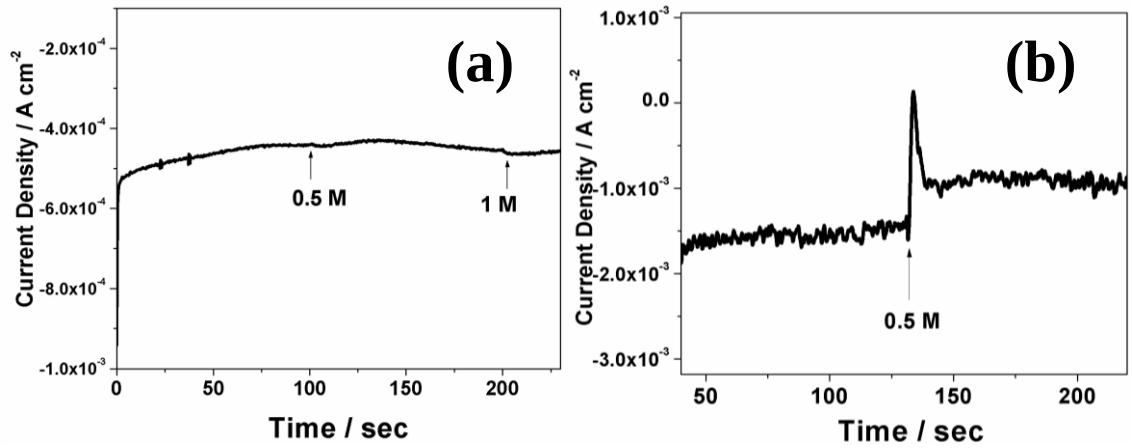

Figure S10. I-t transients recorded at -0.35 V vs. MMO in O_2 saturated 0.5 M KOH on (a) TiC-NW and (b) 40 wt% Pt/C. The addition of methanol is shown in figure. Loading of Pt/C used is 44 µg/cm^2

References

1. Robinson, K. S.; Sherwood, P. M. A. *Surf. Interface Anal.* **1984**, *6*, 261.

2. Bertoncello, R.; Casagrande, A.; Casarin, M.; Glisenti, A.; Lanzoni, E.; Mirenghi, L.; Tondello, E. *Surf. Interface Anal.* **1992**, *18*, 525.