Titania Nanotube Array/Bismuth Oxide Interfacial Capacitance Electrode

York R. Smith[a], Biplab Sarma[a], Abraham L. Jurovitzki[a], Swomitra K. Mohanty[b], Mano Misra[a,b*]

[a]Metallurgical Engineering Department, University of Utah
[b]Chemical Engineering Department, University of Utah
Salt Lake City, UT 84108

Titania nanotube arrays (T-NTA) synthesized by electrochemical anodization have received considerable attention for a variety of applications [1] including supercapacitors [2, 3]. Composites of T-NTA with other transitional metal oxides such as NiO [4], for example, produces an interfacial capacitance of 128 mF/cm^2. Recently, we have examined the interfacial capacitance of a T-NTA/Bi_2O_3 composite electrode [5].

Bismuth oxide phase was electrochemically deposited onto the T-NTA. The effects of deposition current density and time on morphology evolution of the bismuth oxide phase were analyzed. It was found that under optimized deposition conditions, equiaxed crystal morphology could be achieved (Fig 1) resulting in a maximum interfacial capacitance of 430 mF/cm^2 in 1 M NaOH electrolyte. The highly ordered T-NTA substrate along with equiaxed Bi_2O_3 particle deposition helps facilitate enhanced reaction sites thereby increasing the interfacial capacitance.

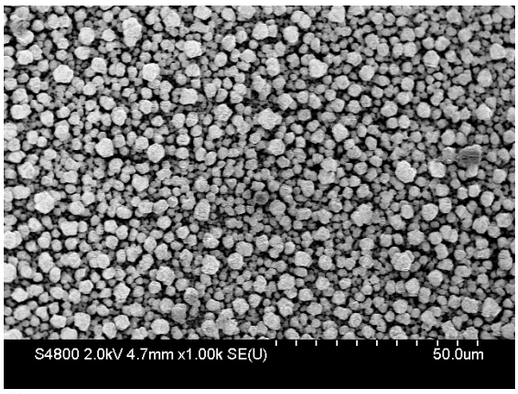

Fig 1.

The electrochemical capacitance was examined by conducting cyclic voltammetry and galvanostatic charge-discharge experiments. These studies demonstrated a dependence on the morphology and distribution of the bismuth oxide phase. Galvanostatic charge-discharge studies show stable capacitance with high retention even after 500 cycles of continuous operation (Fig. 2).

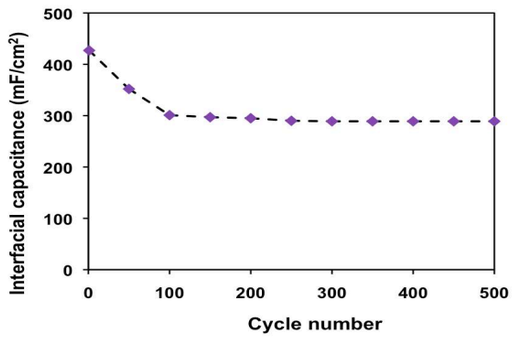

Fig. 2

References

[1] Schmuki *et al*, *Angew Chm Int Ed*, **2011**, *50*, 2904
[2] Park *et al*, *J Electrochm Soc*, **2009**, *156*, A584
[3] Li *et al*, *Nano Lett*, **2012**, *12*, 1690
[4] Lu *et al*, *Electrochim Acta*, **2008**, *53*, 3643
[5] Misra *et al*, *ACS Appl Mater Interfaces*, **2013**, *5*, 1688

* Corresponding author: mano.misra@utah.edu