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## Green synthesis of NiO nanoparticles using *Callistemon viminalis*' extracts & their potential for pseudocapacitor applications

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P-type Bunsenite NiO powders with an average crystallite size of 21 nm (as shown by x-ray diffraction analysis) were produced via biosynthesis and heat treatment, using aqueous extracts from flowers of the plant *Callistemon viminalis*. SEM showed that the NiO powders consisted of particles with sizes in the 20-35 nm range while XPS confirmed the formation of highly pure NiO. From Raman spectroscopy, strong 1 phonon vibration at 507.4 cm<sup>-1</sup> and the existence of a broadened 2-phonon band of reduced intensity at 1096 cm<sup>-1</sup> confirmed that biosynthesized NiO powders were not only defect-rich/ rich in surface effects but were also nanosized with dimensions less than 100 nm. Using UV-Vis-NIR spectroscopy the optical band gap for a spin coated thin film of NiO obtained by spin coating onto glass the green coloured Ni<sup>2+</sup>-containing aqueous extract of *Callistemon viminalis* red flowers, then annealing in air, was calculated to be 3.35 eV. A cyclic voltammetric study of the redox processes in thin films of the NiO nanopowders on Ni showed the redox processes to be quasi-reversible with the films showing good potential for pseudocapacitance. From our calculations the specific capacitance of the NiO thin films on Ni was estimated at 101 F/g, a value close to that reported in the literature. This method demonstrates that the use of natural plant extracts can be a cost-effective and environmentally friendly alternative to preparing Nickel oxide nanoparticles that can be of use in a variety of energy storage applications.

### Biography

B.T. holds a PhD in Chemistry from the University of the Western Cape, South Africa. He is currently a DST-NRF Innovation Postdoctoral fellow at the UNESCO-UNISA Africa Chair for Nanosciences & Nanotechnology, and is hosted by the Materials Research Dept't of iThemba LABS. He has published more than 16 papers and proceedings in ISI peer reviewed journals and conference proceedings. His interests lie in the area of gas sensing, electrochromism, energy storage, solar cells.

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