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Authors: Noluthando Mayedwa, Nametso Mongwaketsi, Saleh Khamlich, Kasinathan Kaviyarasu, Nolubabalo Matinise, Malik Maaza



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# Green Synthesis of Nickel Oxide, Palladium and Palladium Oxide Synthesized via *Aspalathus Linearis* Natural Extracts: Physical Properties & Mechanism of Formation

Noluthando Mayedwa<sup>1,2\*</sup>, Nametso Mongwaketsi<sup>1</sup>, Saleh Khamlich<sup>1,2</sup>, Kasinathan  
Kaviyarasu<sup>1,2</sup>, Nolubabalo Matinise<sup>1</sup>, Malik Maaza<sup>1,2</sup>

<sup>1</sup> iThemba Laboratories for Accelerator Based Science, Somerset West- 7129, South Africa

<sup>2</sup> College of Graduate Studies, University of South Africa, UNESCO-Africa Chair in  
Nanoscience and Nanotechnology, Theo Van Wyk Building 9-119, South Africa.

nmyedi@gmail.com, nanky@tlabs.ac.za, skhamlich@tlabs.ac.za,  
kasinathankaviyarasu@gmail.com, nmatinise@tlabs.ac.za, Maaza@tlabs.ac.za

## Highlights

- Biosynthesis of nickel oxide, palladium and palladium oxide nanoparticles using *Aspalathus Linearis* natural extracts.
- Nanoparticles were annealed at 200 and 500 °C and characterized by HRTEM, XRD and FTIR.
- Mechanism of reaction is proposed of bioactive orientin as a representative bioactive compound with nickel precursor.
- Electrochemical activity was confirmed by cyclic voltammetry and electrochemical impedance spectroscopy

## Abstract

The biosynthesis of PdO and NiO nanoparticles (NPs) via *Aspalathus Linearis* natural extracts as reducing and capping agent and calcinated at 200 and 500 °C. High Resolution Electron Microscope (HRTEM) was used to determine the morphology of PdO NPs exhibited tetragonal and NiO NPs agglomerated quasi spherical shape. The average diameter for PdO NPs is ( $f_{\text{particle}}$ )  $\sim 22.7 \pm 4.3$  nm and NiO NPs is  $\sim 31.8 \pm 5$  nm. Selected Area Electron Diffraction (SAED) and X-ray diffraction confirmed both nanoparticles are polycrystalline. Mechanism of reaction is proposed and Infrared spectroscopy confirmed the chemical bonding of the natural extract to the NPs, at 451 and 683  $\text{cm}^{-1}$  for Pd and PdO and 481  $\text{cm}^{-1}$  NiO NPs. Cyclic voltammetry showed oxidation peak potential for PdO NPs was 0.5 and 0.64 V and reduction peak at 0.68

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