

# Opto-structural and Surface Properties of Silkworm-like Nickel Oxide Thin Films

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## Abstract

Nickel oxide (NiO) is one of the most promising transparent conducting oxides. The optoelectronic and electrochemical properties of these materials depend on their morphology and affected by the preparative parameters. In this study, the effects of annealing temperature (AT) on the surface morphology and opto-structural properties of a sol-gel prepared NiO thin films are reported. Raman spectra showed two main bands at 560 and 1079  $\text{cm}^{-1}$ , arising from O–O planar and Ni–O stretching vibrations, respectively. Atomic force microscopy (AFM) analysis illustrated that AT enhances the silkworm-like morphology and the films' roughness. XRD and Raman analysis, as well as AFM investigation confirmed the crystallinity improvement after annealing. UV-vis-NIR spectroscopy showed that the films are highly transparent (40 – 97 %) and their bandgap decreased from 4.05 to 3.88 eV. The refractive index, porosity, packing density, and the dispersion parameters found to be sensitive to AT. Water contact angle measurements showed that the un-annealed film is hydrophilic. The films' wettability decreased significantly with AT. Based on the obtained results, the films are a candidate for electrochemical, transparent heat mirrors and optical windows applications.

**Keywords:** NiO thin films; Silkworm-like morphology; Opto-structural parameters; Refractive index; Wettability.