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Effect of Substrate Position on the Growth, Texture, and Optical Properties of NiO Thin Films Deposited by RF Magnetron Sputtering

Nickel oxide (NiO) is a wide-bandgap p-type semiconductor that has attracted considerable interest for optoelectronic applications, particularly as a hole-transport layer in photovoltaic devices [1]. In this work, NiO thin films were deposited on borosilicate glass and n-type Si substrates by reactive RF magnetron sputtering under well-defined growth conditions, structural and optical properties were systematically investigated. X-ray diffraction confirms the formation of polycrystalline NiO with a pronounced (200) preferred orientation, which progressively decreases for films located farther from the substrate center. This behavior indicates a position-dependent evolution of the film structure, associated with variations in deposition conditions, systematic changes in lattice parameters and grain size across the substrate. Fourier-transform infrared spectroscopy show Ni–O lattice vibrations, along with Si–O–Si stretching modes attributed to the formation of an interfacial silicon oxide layer. Optical properties were analyzed by spectroscopic ellipsometry in the visible–near-infrared range. The refractive index, extinction coefficient, and optical band gap (3.6–3.9 eV) confirm the wide-bandgap nature of NiO, with absorption mainly in the ultraviolet region and visible response influenced by film thickness and microstructure. [1] Current Photovoltaic Research 13(2) 61-76 (2025).

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