

Perovskite NdNiO₃ Electrochromic Visualization Sensor

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The application of electrochromic technology in the field of sensors is an emerging and promising direction. It utilizes the reversible color change of a material when a voltage is applied to convert an electrical or chemical signal, which is difficult to observe directly, into an optical signal (color change) that is directly visible. This study develops a reversible electrochromic sensor based on proton-mediated regulation in NdNiO₃ thin films, enabling naked-eye visualization of weak electric field signals. The NdNiO₃ electrochromic sensor leverages electric-field-controlled insertion/extraction of hydrogen ions (H⁺) within the NdNiO₃ lattice to trigger a Mott transition. Under a positive electric field, H⁺ from the solution injects into the lattice, forming hydrogenated neodymium nickelate (HNdNiO₃). This alters the electronic orbital occupancy of Ni³⁺ (double eg orbital occupation), transitioning the material from a metallic state (low resistance, high reflectivity) to an insulating state (high resistance, high absorption), accompanied by a significant decrease in visible-light transmittance (54.5% optical modulation). Applying a reverse electric field extracts H⁺, restoring the original metallic state and achieving reversible optical/electrical switching. This mechanism converts imperceptible electrical signals into intuitive optical readouts, combining high sensitivity, rapid response kinetics, nanoscale spatial manipulation capability, as well as excellent cyclic stability (94.9% of the initial optical modulation is still retained after 1150 cycles). As such, it provides a groundbreaking tool for applications spanning marine exploration, biomedicine, and smart windows.

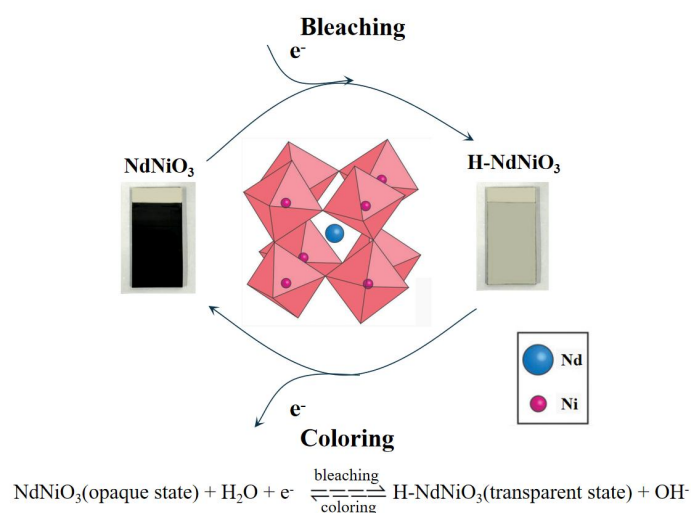


Figure 1. Schematic diagram of the working principle of perovskite NdNiO₃ thin film.

Keywords: Electrochromic; Visualization Sensor; NdNiO₃; Mott transition; high sensitivity