

# CHROMOGENIC MATERIALS FOR SMART WINDOWS

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Chromogenic thin films, including electrochromic, thermochromic, and photochromic types, are pivotal for the advancement of Smart Windows, which are expected to significantly enhance energy efficiency in the near future. Within the framework of the EU HORIZON project "Smart Windows for Zero Energy Buildings" innovative chromogenic metal oxide thin films [1-4] have been developed. These coatings were fabricated using advanced Reactive High Power Impulse Magnetron Sputtering (HiPIMS) and scalable industrial roll-to-roll (R2R) technology, making them suitable for Smart Window applications.

We investigate chromogenic metal oxides thin films, including tungsten, molybdenum, iridium, nickel, and their mixed oxides, comparing them to related crystalline species to establish the structure-property relationships. Building on our pioneering works [6] from the 1990s, we have utilized X-ray Absorption Spectroscopy, Raman spectroscopy, FTIR, and other techniques to examine cathodic electrochromic oxides such as WO<sub>3</sub>, WO<sub>3</sub>-NiO, MoO<sub>3</sub>, and ReO<sub>3</sub>-WO<sub>3</sub>, as well as anodic oxides like NiO<sub>x</sub>, IrO<sub>x</sub>, ZnO-IrO<sub>x</sub>, NiO-VO<sub>x</sub>, and NiO-IrO<sub>x</sub>. Recently, we have extended our research to the superconducting Y-H and photochromic Y-O-H systems [4, 5].

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