Session	Advanced Coating Technologies (II)
Date	APRIL 11, 2025
Time (CET)	14:15 - 14:30
Chair	Hasan İsmail

Chromogenic Thin Films for Smart Windows

Juris Purans

Institute of Solid-State Physics, University of Latvia, Latvia

Biography

Prof. Juris Purans is a distinguished full member of the Latvian Academy of Sciences and the head of the Thin Films Laboratory at the Institute of Solid State Physics, University of Latvia. He earned his PhD for groundbreaking work on the machine modeling of glass structures and achieved habilitation from the University of Latvia in 1993 for pioneering studies in high-temperature superconductors (HTSC) and X-ray Absorption Fine Structure (XAFS) spectroscopy of transition metal oxides at synchrotron radiation facilities. Prof. Purans established the EXAFS Laboratory at the Institute of Solid State Physics in 1993, creating a hub of excellence in XAFS research and training a generation of specialists in this field (www.dragon.lv/exafs). His international reputation led to visiting professorships at leading universities in France, Italy, Switzerland, and Russia, and extensive collaborative work at renowned synchrotron facilities, including ADONE/DAFNA, LURE-SOLEIL, ELETTRA, HASYLAB, and ALBA.

In 2017, Prof. Purans founded the Thin Films Laboratory (www.dragon.lv/tfl), specializing in advanced deposition techniques such as High Power Impulse Magnetron Sputtering (HIPIMS), Metal Organic Chemical Vapor Deposition (MOCVD), and Pulsed Laser Deposition (PLD) for functional thin films and nanocoatings. A leading expert in Synchrotron Radiation, EXAFS, Raman, and EPR spectroscopies, his research focuses on transparent conducting, electrochromic, thermochromic, ferroelectric, and superconducting oxides.

Prof. Purans has published over 300 scientific papers with a Web of Science h-index of 38 and serves as the Principal Investigator of the EU HORIZON ERA-Chair project "Smart Windows for Zero Energy Buildings." His contributions have been recognized with numerous accolades, including the Latvian Academy of Sciences Awards (2010, 2013, 2014, 2015, 2019), the City Council of Riga Award (2019), and the prestigious "Fibonacci" Prize from the Rome International Center for Materials Science of Superstripes (awarded by Prof. Antonio Bianconi).

Abstract

Chromogenic thin films (electrochromic, thermochromic, and photochromic) are at the forefront of smart window development, which is anticipated to play a pivotal role in energy conservation for the buildings of the future. Within the EU HORIZON project Smart Windows for Zero Energy Buildings, innovative single and multi-layered transition metal oxide (TMO) thin films have been designed and fabricated. These include ReO_3-WO_3, MeO-IrO_2, WO_3/Cu/WO_3, and rare-earth metal oxy-hydrides (REHO) such as Y-H-O, utilizing advanced Reactive High-Power Impulse Magnetron Sputtering (R-HiPIMS) and industrially scalable roll-to-roll (R2R) deposition techniques.

Building on pioneering work initiated in the 1990s, synchrotron radiation studies have been extensively applied to investigate cathodic electrochromic oxides such as WO_3, MoO_3, and ReO_3-WO_3, as well as anodic oxides including NiOx, IrOx, and NiO-IrOx. Among these materials, REHO thin films represent a groundbreaking class of inorganic mixed-anion compounds with exceptional photochromic properties, including pronounced light-induced resistivity changes. Recent advancements extend these investigations to photochromic Y-O-H systems and antibacterial coatings like WO_3/Cu/WO_3, highlighting their potential for multifunctional applications.

Additionally, large-area roll-to-roll deposition of YHO and WO_3/Cu/WO_3 has been explored to enable scalable production for smart windows and other optoelectronic devices. This work underscores the potential of advanced chromogenic materials to transform energy-efficient building technologies, offering a significant contribution to achieving zero-energy goals.

Keywords

chromogenic, smart windows, thin films, HIPIMS deposition

Notes

Financial support was provided by the Project “Smart Windows for Zero Energy Buildings” (SWEB) GA nr. 101087367.