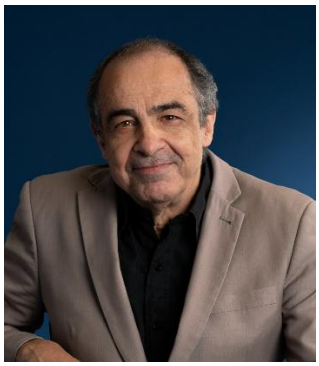

**Name of the keynote speaker: Mohamed Chaker**
**Affiliation: Institut national de la recherche scientifique, Canada**

## Short biography

Mohamed Chaker has been a professor at the Institut National de la Recherche Scientifique (INRS) in Varennes, Quebec, Canada since 1989. He held a Tier 1 Canada Research Chair in Plasmas applied to micro and nanomanufacturing technologies from 2003 to 2024 and published over 360 articles in peer-review journals (18500 citations, H-index=75 according to Google Scholar) in various domains, including advanced plasma sources characterization (high-density plasmas and laser-induced plasmas) for applications to thin film and nanomaterials synthesis, nanometer pattern transfer and device fabrication. From 1999 to 2002, he has been the director of the Center Energie et Matériaux of INRS, then from 2002 to 2005, the director of the Center Énergie Matériaux Télécommunications. He played a leadership role in the development of Quebec consortia (Prompt-Québec, NanoQuébec). From 2005, he is the director of the Laboratory of Micro and Nanofabrication (LMN) of INRS. *Email: mohamed.chaker@inrs.ca*

## Title of the keynote talk: Plasma-based Synthesis of Oxide Materials

## Abstract of the keynote talk

The ability to control the structure of materials at the nanoscale is yielding new functional materials with exceptional properties (electrical, optical, magnetic, photocatalytic, etc.). One of the most versatile means to arrange matter at the nanoscale is through the use of plasmas. Plasmas are remarkable due to their capability to provide simultaneously a variety of particles, namely ions, neutral atoms and radicals, and photons, all within a non-equilibrium environment. Plasmas are therefore unique in their ability to synthesize inorganic and organic materials in the form of either thin films or nanomaterials. In this context, I will report innovative plasma-based materials processes aiming at developing advanced oxide materials. These novel materials can then be exploited to conceive the next generation of photonic devices of ever-increasing complexity, performance and functionality or advanced environmental and energy applications such as water treatment and green hydrogen production. In particular, I will focus on the use of Pulsed Laser Deposition (PLD) for the synthesis of undoped and doped vanadium dioxide and titanium oxide.

Vanadium dioxide ($VO_2$) displays a sharp reversible metal-insulator transition (MIT) in response to external stimuli, such as temperature (transition at 68°C), electric fields and optical signals. This transition is accompanied by a dramatic variation of electrical resistivity and reflectivity in the infrared and THz domains. Among the achievements of my team, I will present: (i) the demonstration of a photo-induced phase transition to a long-lived state with metal-like mid-IR optical properties, but with the lattice-charge order of the semiconducting phase intact; (ii) the influence of various dopant elements, namely tungsten, boron, nitrogen and chromium, and of their concentration on the MIT and phase stabilities; (iii) the optical property changes in $VO_2$ for different dopants using Density Functional Theory (DFT), separating structural and electronic effects in order to connect these changes to the elemental properties of the dopants; (iv) the influence on the MIT of tungsten doping combined with interfacial strain induced by (001) R-$TiO_2$ substrates; and (v) an innovative method to synthesize high-quality $VO_2$ thin films on large area scale and at low temperature, paving the way to new applications requiring deposition on heat-sensitive flexible polymer substrates.

In addition, I will also report our most recent achievements on titania-based photocatalysts synthesized by PLD. In particular, six-layer multiple-homojunction nitrogen-gradient doped $TiO_2$ (g-N-$TiO_2$) was fabricated with highly improved photocatalytic performance for water purification and photocurrent generation compared to bare $TiO_2$ and simple doped N-$TiO_2$. The improved performances of g-N-$TiO_2$ is attributed to the 1D structure, high-quality interfaces and extended internal electric field that facilitate charge-carrier transport and separation. To further improve the photoconversion efficiency, $BiVO_4$ was grown on the outermost surface of black titanium oxide nanotube arrays, which yields a high unassisted photocatalytic removal efficiency for a hard-to-treat antibiotic under visible light irradiation.