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Innovative process of micro-nanostructure of titanium nitride (TiN) by association of a photostructurable titanium oxide (TiO₂) and a rapid thermal annealing (RTA).

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The titanium nitride (TiN) is usually used for its thermal, mechanical, electrical and optical properties. Its micro-nanostructure allows to use it in a wide range of applications especially in the area of optic [1] and photocatalysis [2]. These properties combined make this material a promising alternative of gold and silver for optical applications at high temperature or in extreme environment.

The fabrication of microstructured or nanostructured surfaces in TiO₂ and in TiN on large substrates with plane or complex geometry is a challenge. Due to their high thermal, chemical and mechanical stability, TiN layer are difficult to micro-nanostructure by etching or engravement after their deposition. An alternative route is to micro-nanostructure titanium oxide film (TiO₂) before converting it into TiN by a nitridation process [3,4].

In this presentation, a new method of elaboration of micro-nanostructured TiN layer from a TiO₂ photostructurable sol-gel by rapid thermal annealing (RTA) will be presented. This sol-gel is photostructurable by optical lithography and nano-imprint lithography (NIL), allowing an easy and quick production of micro-nanostructure TiO₂ layers (figure 1). These layers can then be converted into micro-nanostructure TiN layers thanks to an RTA of few minutes under ammonia flux. The micro-nanostructured films have been characterized by X-ray diffraction, Scanning Electron Microscopy (SEM), Spectroscopy RAMAN... The optical and electrical properties have been studied and a plasmonic application will be presented.

References (max. 5):

- [1] Usuga Higueta, M. A. et al. Opt. Mater. Express 2021, 11 (1), 12
- [2] Crespo-Monteiro, N. et al. Nanomaterials 2022, 12 (6), 1008.
- [3] Valour, A.; Usuga Higueta, M. A; et al. J. Phys. Chem. C 2020,
- [4] Valour, A. et al. Surface and Coatings Technology 2021, 413, 127089.

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*Check the 17 sustainable development goals on the United Nations website:
<https://www.un.org/sustainabledevelopment/sustainable-development-goals>