Thermochromic VO_2 thin films for smart window applications and temperature-controlled plasmonic response

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Monoclinic VO_2 (m-VO_2) undergoes a Metal-to-Insulator Transition (MIT) at ~67°C and is labelled as thermochromic. In this study, we first demonstrate how magnetron sputtering of a vanadium target in an Ar/O_2 mixture can be optimized to synthesize films containing m-VO_2 nanocrystals. The thermochromic material is obtained at a precise oxygen flow rate and in specific annealing conditions. In the second part, numerical results obtained by the CAMFR code (CAvity Modelling Framework) are compared to the optical properties of the synthesized films. Thanks to simulations, we manipulate the VO_2 film nanostructure and propose a way to improve the film properties for an application as smart windows. By optimizing the VO_2 nano-ribbon width, periodicity, and the film thickness, one can enhance the performance in terms of energy saving and opacity as compared to a dense film of identical thickness [1].

Finally, we demonstrate how the m-VO_2 films can be combined with gold nanoparticles (Au-NPs) to obtain tunable plasmonic signal according to the temperature. A shift in wavelength of the plasmonic peak is evidenced as a function of the temperature. The here-mentioned work may pave the way towards the elaboration of thin film materials with superior optical accordability which can potentially be used in applications such as colour display, protection against counterfeiting, and opto-electronics chips.

References:

[1] G. Savorianakis, K. Mita, T. Shimizu, S. Konstantinidis, M. Voué, and B. Maes, "VO_2 nanostripe-based thin films with optimized color and solar characteristics for smart windows," *J. Appl. Phys.*, vol. 129, no. 18, p. 185306, May 2021, doi: 10.1063/5.0049284.