Tunable VO_2 cavity enables multispectral manipulation from visible to microwave frequencies

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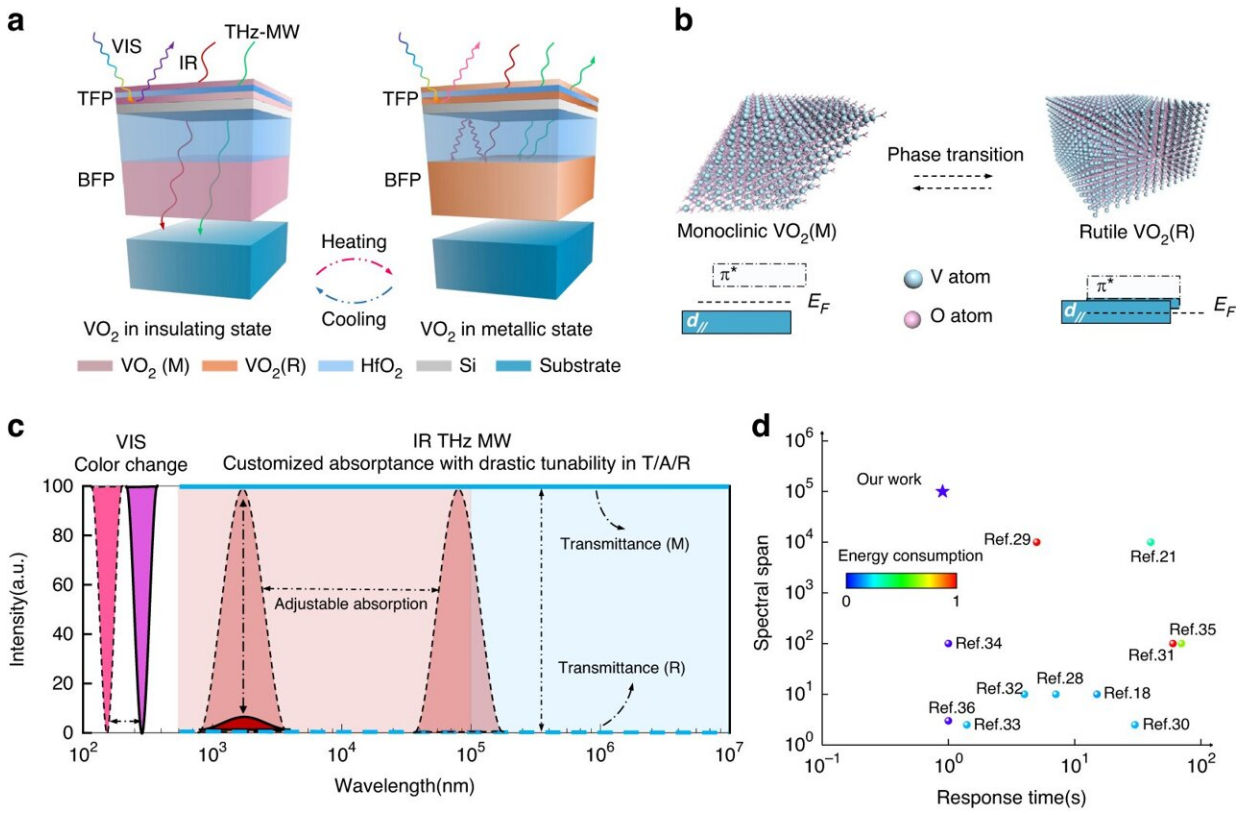

Schematic of proposed system with its operating principle. Credit: *Light: Science & Applications* (2024). DOI: 10.1038/s41377-024-01400-w

Optical materials capable of dynamically manipulating electromagnetic

waves are an emerging field in memories, optical modulators, and thermal management. Recently, their multispectral design preliminarily has attracted much attention, aiming to enhance their efficiency and integration of functionalities. However, the multispectral manipulation based on these materials is challenging due to their ubiquitous wavelength dependence restricting their capacity to narrow wavelengths.

In a new paper published in *Light: Science & Applications*, a team of scientists, led by Professor Yao Li from Center for Composite Materials and Structure, Harbin Institute of Technology, 150001, Harbin, China, Professor Cheng-Wei Qiu from National University of Singapore, Department of Electrical & Computer Engineering, Singapore, and co-workers cascade multiple tunable optical cavities with selective-transparent layers, enabling a universal approach to overcoming wavelength dependence and establishing a multispectral platform with highly integrated functions.

They demonstrate the multispectral (ranging from 400 nm to 3 cm), fast response speed (0.9 s), and reversible manipulation based on a typical phase change material, vanadium dioxide (VO_2).

The platform involves tandem VO_2-based Fabry-Pérot (F-P) cavities enabling the customization of optical responses at target bands independently. It can achieve broadband color-changing capacity in the visible region (a shift of ~60 nm in resonant wavelength) and is capable of freely switching between three typical optical models (transmittance, reflectance, and absorptance) in the infrared to microwave regions with drastic amplitude tunability exceeding 0.7.

In addition, the ultrafast phase transition of VO_2 enables faster response time of 0.9 s compared to electrochromic materials-based systems.

More information: Hang Wei et al, Tunable VO2 cavity enables

multispectral manipulation from visible to microwave frequencies, *Light: Science & Applications* (2024). DOI: 10.1038/s41377-024-01400-w

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