



Seminar/Talk

Transient Electronic and Structural States in Vanadium Dioxide

Daniel Kazenwadel

University of Konstanz

Host: Charles Roques-Carmes

Vanadium dioxide (VO) and its enigmatic insulator-to-metal transition near room temperature have been intensively studied since their discovery in the 1960s [1]. In this talk, I will report results on a variety of transient states that emerge during the transition under different external stimuli. When VO is slowly heated through the transition, the process is dominated by microscopic cooperativity [2], giving rise to phase fluctuations and supercooling phenomena [3]. When the material is driven across the transition by femtosecond laser excitation, there is a transient state with phase coexistence of insulating and metallic domains. We observe it with energy-filtered ultrafast electron diffraction [4] using photoemitted electrons from the nanometer-sized tip of a transmission electron microscope [5]. At high excitation fluences, we uncover evidence for a short-lived plasmonic state of canalized light that can be used to write directional and switchable surface structures [6].

1. F. J. Morin, Oxides which show a metal-to-insulator transition at the Neel temperature. *Phys. Rev. Lett.* 3, 34–36 (1959).
2. J. Holder, D. Kazenwadel, P. Nielaba, P. Baum, Determination of the nearest-neighbor interaction in VO via fractal dimension analysis *Phys. Rev. Res.* 5, 043272 (Dec. 2023).
3. D. Kazenwadel, R. Schwenzer, E. Steiner, J. Holder, P. Baum, Spontaneous supercooling by rapid domain collapse. Manuscript in preparation.
4. D. Kazenwadel, J. Holder, P. Nielaba, P. Baum, Disorder explains the ultrafast photo-induced hidden phase in VO₂. Manuscript in preparation.
5. D. Kazenwadel, J. Holder, J. Kuttruff, P. Baum, Energy offset between femtosecond and thermal electrons in nanometer field-emitter tips. *Phys. Rev. Appl.* 24, 024021 (2025).
6. D. Kazenwadel, N. Neathery, P. Baum, Canalized light creates directional and switchable surface structures in vanadium dioxide. *Nat. Commun.* 16, 3960 (2025).

Laser-induced periodic surface structures in VO₂ [6]. DANIEL KAZENWADEL, b. 1995, MSc in Physics (University of Konstanz, 2020); PhD student (University of Konstanz, 2020–present)

Monday, October 20, 2025 10:00am - 11:00am

Mondi 2, Central Building



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