European XFEL Science Seminar

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Video conference, via Zoom

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Non-thermal photo-induced metallic phase emerging from nanoscale complexity in correlated quantum materials

The interplay between electronic and lattice degrees of freedom in correlated materials often leads to spontaneous nanoscale architectures, which can favour and stabilize photoinduced emergent states with no counterpart at equilibrium. State-of-the-art light excitation protocols offer space-integrated information, which are insufficient to link and control the temporal and real-space dynamics of non-equilibrium states. Here, we report time-resolved photoemission microscopy experiments on a V_2O_3 thin film, which at equilibrium undergoes a transition at T≈140 K from intrinsically nanotextured monoclinic insulator to homogeneous corundum metal. We demonstrate that the excitation with infrared light pulses turns the low-T insulating phase into a non-thermal metallic state that retains the monoclinic in-plane shear strain. Mean-field modelling shows that the topology of the monoclinic nanotexture is key for stabilizing the emergent photo-induced metal state. Engineering the nanotexture of insulating strained domains may thus constitute a new tool to control non-thermal phases in correlated materials.

Host: Sakura Pascarelli

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