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Element specific channels in photo-excitation of V–doped TiO_2 nanoparticles

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Refined X-ray spectroscopies can be crucial in elucidating charge transfer phenomena which play a key-role in photo-catalysis and other processes relevant for clean energy production. A deep understanding of electron photo-dynamics is, in fact, essential to develop efficient knowledge-based devices. We developed a differential illumination RIXS and HERFD-XAS [1], method on ID26 @ ESRF to investigate charge transfer phenomena with chemical sensitivity; specifically, we studied V-doped TiO2 nanoparticles, a promising materials system for photo-catalysis, performing measurements around both the V Kα and Ti Kβ emissions. We found that visible light absorption induces the transfer of electrons from the V dopants to the host matrix cations in defective sites. With a steady state model, it was also possible to estimate the lifetime of the excited state. The value we obtained (around 1 ms) suggests that dopant-injected electrons can remain trapped near Ti atoms for a very long time. The procedure we used is completely general and can be successfully applied to detect any kind of long-living charge transfer phenomena in a wide range of possible devices [2].

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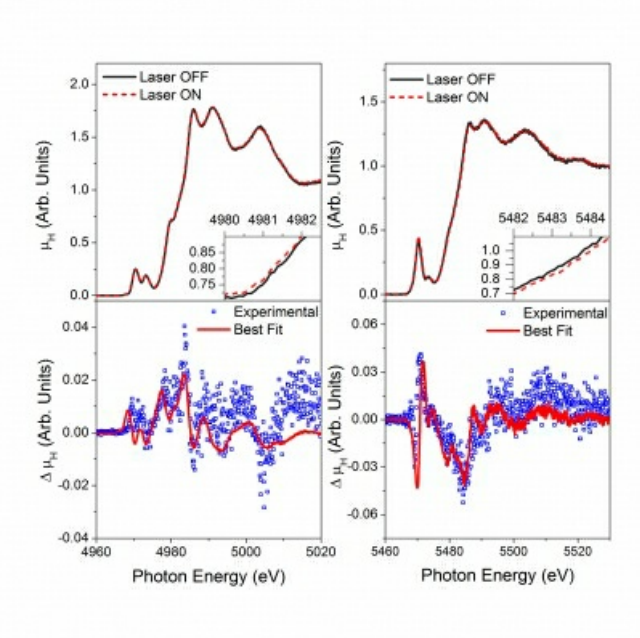

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