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Monitoring photoinduced charge carrier dynamics in Au nanoparticle–sensitized TiO2 with time-resolved X-ray photoelectron spectroscopy.[1] MARIO BORGWARDT, JOHANNES MAHL, Lawrence Berkeley National Laboratory, FRIEDRICH ROTH, TU Bergakademie Freiberg, WOLFGANG EBERHARDT, Center for Free-Electron Laser Science / DESY, OLIVER GESSNER, Lawrence Berkeley National Laboratory — The combination of plasmonic metal nanoparticles (NPs) and photocatalytically active semiconductor (SC) materials provides a promising route toward improved solar energy conversion schemes. The currently accepted model for plasmon-induced charge-separation processes is based on ultrafast surface plasmon damping and dephasing, resulting in the population of hot electrons that are able to undergo transfer to the semiconductor. A considerable number of time-resolved studies in the visible and IR regime have been reported, which are mainly sensitive to the free electron charge densities in the SC acceptor. Very little information, however, is available about time-dependent charge- and energy-distributions from the viewpoint of the plasmonic NPs and about the transient interfacial band structure. Here, we study a model system consisting of a nanoporous TiO2 layer sensitized with gold nanoparticles (Au NPs) using picosecond laser pump – X-ray probe photoelectron spectroscopy (trXPS). The element-specificity of trXPS allows to simultaneously monitor both local charge distributions as well as local band structure dynamics from the individual perspectives of the electron donor (Au NPs) and the electron acceptor (TiO2).

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