Lifetimes of electron excitations on clean and nanostructured metal surfaces

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Interaction between lattice and electron subsystems as well as interaction within each of these subsystems is crucial to understand mechanisms of single-particle excitation dynamics, i.e. lifetime of excitations. The lifetime sets the duration of excitation and in combination with the velocity determines the mean free path, a measure of influence of the excitation. In this presentation I discuss recent theoretical results on the decay of excited electrons and holes on clean metal surfaces, at single adatoms, at islands as well as in overlayers and free standing thin films. Different decay mechanisms and different kinds of interactions - elastic and inelastic electron- electron (e-e) interaction as well as electron-phonon (e-ph) interaction and the role of spin (spin-orbit and exchange interaction) - are analysed. E-ph decay channel is shown to be important for all systems considered. In the e-e decay channel the electron (hole) decay can be realized via creation of electron-hole pairs or plasmon excitation. Dimensionality effects in the lifetime of electrons and holes on metal surfaces and the role of screening and intra- (inter-) band transitions are also discussed.