ELECTRON DYNAMICS ON THE GD (0001) SURFACE

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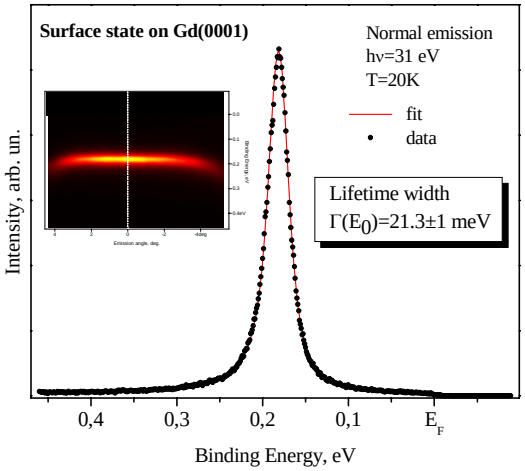
Angle resolved photoemission spectroscopy (ARPES) technique has become a powerful tool for studying of impact on conduction electrons from interaction with low-energy excitations such as phonons and magnons. ARPES is capable to reveal momentum- and energy-dependent quasiparticle dynamics in order to establish the quantitative link between the microscopic electronic structure and macroscopic transport phenomena in solids. Most of experimental and theoretical efforts spent so far have been focused on dynamics of the surface states of noble metals. Much less is known on surface states dynamics in the lanthanides, especially ferromagnetic ones. Electron coupling to both lattice and spin waves is expected to be equally important.

Studies on lanthanides are complicated primarily because of the high chemical reactivity and the difficulties associated with growth of defect-free single crystalline films. Therefore, an improved photoemission and sample preparation setup is required to reliably access small effects while working with these delicate samples.



We report on ARPES study of the temperature dependence of lifetime broadening of the surface states in thin epitaxial Gd (0001) films. The low temperature data, shown in the figure, establish new values for the intrinsic lifetime broadening of the surface states. The lifetime width of the surface states is found to be $\Gamma(E_0) = 21$ meV that is noticeably smaller than what was previously extracted from scanning tunneling spectroscopy (STS) measurements [1].

A high degree of the surface order and excellent vacuum condition were enabling us to follow the reversible temperature dependence of the surface states linewidth within the extended temperature range (from 18 K up to 300 K). From these data we extracted an electron-phonon coupling constant $\lambda = 0.5$ which is in close agreement with theoretical calculations [2]. Our data however do not support the temperature-dependent STS and spin-polarized ARPES measurements that both report an electron-phonon coupling constant twice the value found by our ARPES study [3, 4].

We will also discuss the electron-magnon scattering contribution to the linewidth within the framework of spin mixing behavior of the surface states.

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[3] A. Rehbein et al., Phys. Rev. **B** 67, 033403 (2003)
[4] A. V. Fedorov et al., Phys. Rev. **B** 65, 212409 (2002)