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Quantifying many-body effects by high-resolution Fourier transform scanning tunneling spectroscopy STEPHANIE GROTHE, STEVE JOHNSTON, SHUN CHI, PINDER DOSANJH, Department of Physics and Astronomy, Univ. of British Columbia, Vancouver, Canada, SARAH A. BURKE, Department of Physics and Astronomy, Department of Chemistry, Univ. of British Columbia, Vancouver, Canada, YAN PENNEC, Department of Physics and Astronomy, Univ. of British Columbia, Vancouver, Canada — The properties of solids are influenced by many-body effects that arise from the interactions of the electrons with each other and with the multitude of collective lattice, spin or charge excitations. We apply the technique of Fourier transform scanning tunneling spectroscopy (FT-STS) to probe the many-body effects of the Ag(111) surface state. A renormalization of the otherwise parabolic dispersion induced by electron-phonon interactions is revealed that has not previously been resolved by any technique, allowing us to extract the real part of the self-energy. Furthermore, we show how variations in the intensity of the FT-STS signal are related to the imaginary part of the self-energy. We accurately modeled the experimental data with the T-matrix formalism for scattering from a single impurity, assuming that the surface electrons are dressed by electron-electron and electron-phonon interactions. A Debye energy of $\hbar\Omega_D = 14 \pm 1$ meV and an electron-phonon coupling strength of $\lambda = 0.13 \pm 0.02$ was extracted. Our results advance FT-STS as a tool to simultaneously extract real and imaginary parts of the self-energy for both occupied and unoccupied states with a momentum and energy resolution competitive with angle-resolved photoemission spectroscopy.

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