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Optical Investigation of the Charge Dynamics in $Ba(Co_xFe_{1-x})_2As_2$[1]

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We report on a thorough optical investigation over a broad spectral range and as a function of temperature of the charge dynamics in $Ba(Co_xFe_{1-x})_2As_2$ compounds for Co-doping ranging between 0 and 18%. For the parent compound as well as for x=0.025 we observe the opening of a pseudogap, due to the spin-density-wave phase transition and inducing a reshuffling of spectral weight from low to high frequencies. For compounds with $0.051 \leq x \leq 0.11$ we detect the superconducting gap, while at x=0.18 the material stays metallic at all temperatures. We describe the effective metallic contribution to the optical conductivity with two Drude terms, representing the coherent components, and extract the respective scattering rates. Finally through spectral weight arguments, we give clear-cut evidence for moderate electronic correlations for $0 \leq x \leq 0.061$, which then crossover to values appropriate for a regime of weak interacting and nearly-free electron metals for $x \geq 0.11$. We also investigate the optical conductivity with light polarized along the in-plane orthorhombic a- and b-axes of $Ba(Co_xFe_{1-x})_2As_2$ for x=0 and 2.5% under uniaxial pressure across their structural and magnetic transitions. The charge dynamics at low frequencies and temperatures on these detwinned, single domain samples reveals an enhancement of both the scattering rate and Drude weight of the charge carriers along the antiferromagnetic a-axis with respect to the ferromagnetic b-axis. Our findings also allow us to estimate the dichroism, which extends to high frequencies. These results demonstrate the electronic nature of the structural transition found in underdoped Fe-pnictides. Co-authors: A. Dusza, A. Lucarelli, F. Pfuner, J.-H. Chu, I.R. Fischer.

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