# Optical conductivity of the nano-textured phase in 1T-$TaS_2$

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1T-$TaS_2$ is known to form a peculiar nearly commensurate charge density wave (NC-CDW) phase in which the domains of commensurate charge density wave (CDW) phase, several nanometers in size, are separated by a roughly triangular pieces of metallic phase.[1] Contrary to pure 1T-$TaS_2$, where commensurate-CDW/Mott state develops below 180 K, non-metallic NCCDW state may be preserved in slightly doped or pressurized 1T-$TaS_2$, down to very low temperature, where it turns superconducting.[2] It has been argued that superconductivity arises in triangular metallic parts, while DC conductivity is dominated by weak links between them. Here we report the reflectance of pure and intercalated 1T-$TaS_2$, measured between 23 K to 290 K, over a frequency range of 30 $cm^{-1}$ - 37000 $cm^{-1}$, as well as the optical conductivity derived through Kramers-Kronig analysis. Contrary to simple expectations, where two regions of NCCDW phase would show at different frequencies, the measured optical conductivity does not show the separate contribution from CDW and metallic regions. Instead, we observe a single, wide, metallic contribution, extending to 400 $cm^{-1}$, on the top of which the phonon contribution shows above 40 $cm^{-1}$.

[1] A. Spijkerman, Phys. Rev. B **56** 1997 13757

[2] B. Sipos, Nature Mater. **7** 2008 960; P. Xu, Phys. Rev. B **81** 2010 172503