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Far-infrared optical properties and the metal-insulator transition in Ti-doped $Ca_3(Ru_{1-x}Ti_x)_2O_7$ (x=0.03) D. TALBAYEV, Tulane University, T. STANISLAVCHUK, A. SIRENKO, New Jersey Institute of Technology, JIN PENG, Z.Q. MAO, Tulane University — The discovery of the intriguing phase diagram of $Ca_3(Ru_{1-x}Ti_x)_2O_7$ is the new and exciting development in correlated electron ruthenates, as Ti doping drastically changes the material's ground state properties. The undoped $Ca_3Ru_2O_7$ is metallic at high temperature and undergoes an antiferromagnetic transition at 56 K that is followed by a metal-insulator transition at 48 K driven by the opening of a charge density wave gap. A quasi-2D metallic state develops below 30 K. At 5% Ti doping, the metal-insulator transition temperature is T_{MI} =80 K, below which the material is a Mott insulator. By contrast, a weakly localized electronic state is observed at intermediate dopings (2-4% Ti) together with antiferromagnetic long range order. In the undoped $Ca_3Ru_2O_7$, the metal-insulator transition at 48 K is accompanied by the development of a charge gap below 200 cm^{-1}. At low temperatures, a small Drude peak develops below 50 cm-1, resulting from small non-nested metallic pockets of the Fermi surface. We report a far-infrared spectroscopic ellipsometry study of $Ca_3(Ru_{1-x}Ti_x)_2O_7$ (x=0.03) at U4IR beamline of NSLS-BNL. Our data indicate that the low-temperature gap in optical conductivity opens at 1000 cm^{-1}, a dramatically different value from the one in the undoped compound. We relate our observations to the effects of Ti doping - the induced changes in carrier itinerancy and the modified double-exchange and superexchange interactions in the material.

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