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Optical interaction of metal-induced-gap-state electrons and photon-assisted-tunneling electrons at the metal-insulator interfaces[1]

MALLIK MOHD RAIHAN HUSSAIN, University of Dayton, OH, ZHENGNING GAO, Washington University, St. Louis, MO, DOMENICO DE CEGLIA, AEgis Technologies Group Inc, Huntsville, AL, MARIA VINCENTI, University of Brescia, Via Branze, Brescia, Italy, ANDREW SARANGAN, IMAD AGHA, JOSEPH HAUS, University of Dayton, OH, PARAG BANERJEE, Washington University, St. Louis, MO, MICHAEL SCALORA, Charles M. Bowden Research Laboratory, Redstone Arsenal, AL — We experimentally determined the delocalized electron density at metal-induced-gap-states (MIGS) in Au/Al_2O_3 (i.e. metal-insulator or MI) interfaces by applying a sensitive second harmonic generation (SHG) technique. We also observed an enhancement limit in the third harmonic generation (THG) at $Au/Al_2O_3/Au$ (i.e. metal-insulator-metal or MIM) interfaces due to photon-assisted-tunneling (PAT). The Al_2O_3 layer was deposited on planar Au samples using atomic layer deposition (ALD) technique to form Al_2O_3/Au interface. Later, Au nanoparticles of diameter 20nm were immobilized on Al_2O_3 layer to prepare $Au/Al_2O_3/Au$ interface. Second and third harmonic signals were extracted in each step. Simulations were done using finite-element-method to compare with the experimental results. The experimental results match qualitatively to the prediction of quantum conductivity theory (QCT).

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