Supporting Information

Photodynamics Study of $KTaO_3$ Based Conducting Interfaces

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Schematic of Band diagram: To understand the electron position before and after application of light we have drawn a schematic of the band diagram for both EuO-KTO and LVO-KTO samples. Figure S1 shows the schematic of the band diagram of EuO or LVO thin film on KTO (LVO/ EuO-KTO) under (a) 633 nm (b) 532 nm (c) 405 nm wavelengths of laser light. Under 633 nm laser light illumination, only the electrons lying in the valence band (V. B.) of EuO/ LVO (both have band gap around 1.1eV) and electrons lying in the defect states of KTO are excited (process 1_{EVC} and 1_{KDC}) to the conduction band (C. B.). Some of these photogenerated electrons go to the quantum well formed at the interface (process 2_{ECQ}) which increases the interfacial current density. After turning off the illumination, excited electrons return to their original state (process 3_{ECV}, 3_{KCD} and 3_{EQV}). On the other hand, since 532 nm laser light has energy higher than 633 nm, it can excite more electrons lying in the mid gap states of KTO (process 1_{KDC}) which leads to slighter higher photoconductivity in comparison to 633 nm case. After turning off the laser, some of the excited electrons return to their original states but here some got trapped in other defect states (process 4_{KQD}) which leads to small PPC in this case. Further decreases in the laser light wavelength to 405 nm, it can now also excite the electrons lying in the edge states of the V. B. of KTO (process 1_{KVC}) along with the other two processes mentioned above (process 1_{EVC} and 1_{KDC}) and hence number of more electrons are being trapped in defect states leading to higher PPC in this case.

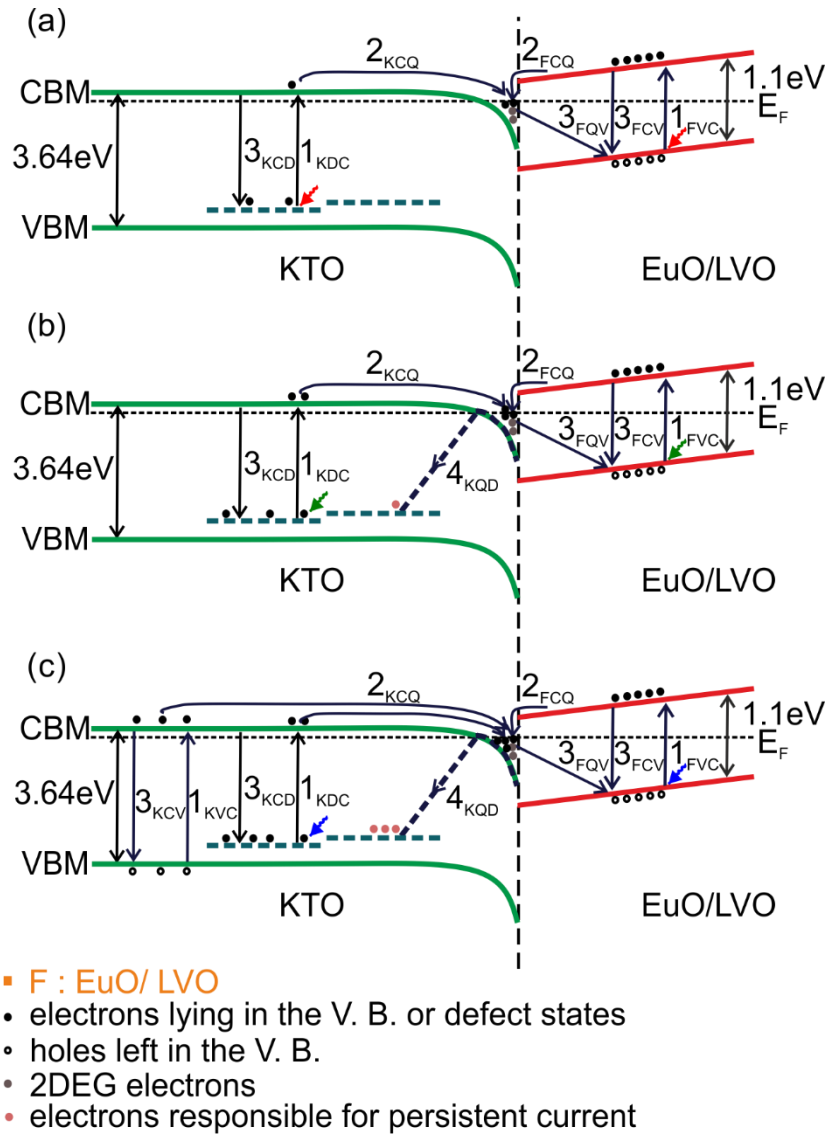

Figure S1: Schematic band structure diagram of EuO/ LVO-KTO sample under (a) 633 nm (b) 532 nm (c) 405 nm laser light illumination.

Surface characterization: We have grown 10 u.c. thick EuO/ LVO film on KTO substrate. Reflection High Energy Electron Diffraction patterns (RHEED) of the EuO-KTO sample and LVO-KTO sample are given in Figures S2 (a) and (b) respectively which clearly depicts crystalline nature of the samples. Figures S2 (c) and (d) shows the AFM image of the EuO-KTO (roughness = 0.115 nm) and LVO-KTO (roughness = 0.172 nm) sample after the growth of film suggesting the smooth surfaces of the films grown.

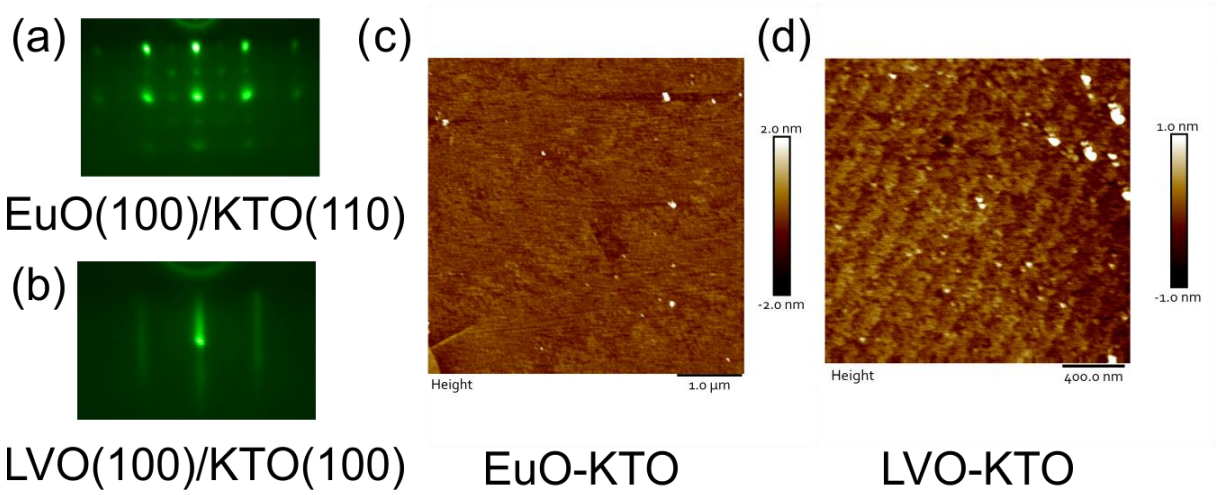

Figure S2: (color online) (a) RHEED pattern for 10 u.c. of (a) EuO film (b) LVO film on KTO substrate respectively. AFM image of the (c) EuO-KTO (d) LVO-KTO sample after the film growth respectively.