Photoexcited *d*-electron dynamics in transition metal oxide MnO studied by optical pump-THz probe measurements

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Optical pump-THz probe (OPTP) measurements allow us to obtain information on the generation and relaxation of photoexcited carriers in materials by observing the transient change of THz transmission after optical excitation. In this study, we carried out OPTP measurements in MnO to elucidate the photoexcited *d*-electron dynamics in a transition metal oxide. At room temperature (RT), photoexcited *d*-electrons induced by a *d*-*d* transition to the lowest excited *d*-state ($^4T_{1g}$) in Mn^{2+} ions show the longest relaxation time, corresponding with an optical absorption peak in Fig. 1 (a). This relaxation time decreases drastically below the antiferromagnetic transition temperature (T_N = 120 K) in Fig. 1 (b), although the structure of the *d*-*d* transition in the optical absorption spectrum remains unchanged [1]. Accompanied with this decrease, the magnetic-excitation-assisted photoluminescence (PL) from the self-trapped exciton (STE) state emerges in Fig. 1 (b) [2]. This suggests that photoexcited *d*-electrons relax to the STE state below T_N (Inset of Fig.1 (b)). These findings shed new light on the photoexcited *d*-electron dynamics, contrasting with the behavior of the photoexcited carriers generated in the upper excited *d*-states (^4E_g, $^4A_{1g}$) that showed relaxation attributable to phonon and magnon scatterings [3].

[1] J. Chem. Phys. **50**, 4092 (1969). [2] J. Phys.: Condens. Matter **4**, 6501 (1992). [3] Proceedings of IRMMW-THz 2012, 10.1109/IRMMW-THz.2012.6380229 (2012).

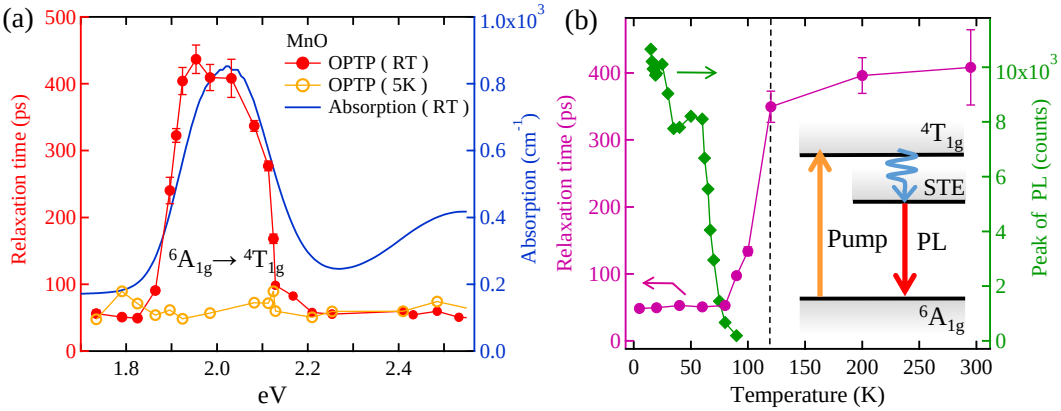

Figure 1 (a) Pump energy dependence of the relaxation time in OPTP and the optical absorption in MnO. (b) Temperature dependences of the relaxation time in OPTP (1.92 eV) and the peak intensity of PL. Inset shows energy diagram describing the excitation and relaxation of *d*-electrons below T_N.