



Contribution ID: 119 Contribution code: P-THU-1

Type: Poster

Hydrogen diffusion observed in photoinduced YO_1H_2 thin films

Thursday, 1 September 2022 18:40 (20 minutes)

Materials showing high photoresponsive electrical resistance have attracted considerable attention due to their photoelectronic applications.[1] Recently, we have reported that yttrium oxyhydride (YO_xH_y) epitaxial thin films exhibit a repeatable photo-induced insulator-to-metal transition by UV laser illumination and thermal relaxation.[2] The photo-induced metallization likely originates from the carrier generation reaction: $\text{H}^- + h\nu \rightarrow \text{H}^+ + 2e^-$, which generates excess electrons and protons.[2,3] This suggests that a local environmental change around hydrogen in the epitaxial YO_xH_y thin film plays an important role in the photo-induced metallization process. To further understand the hydrogen dynamics in the YO_xH_y epitaxial thin film, here, we used ^8Li β -NMR for pristine and UV-illuminated thin films. For the as-fabricated sample, the spin-lattice relaxation rate ($1/T_1$) is constant as $\sim 0.2 \text{ s}^{-1}$ in the temperature range between 100 to 300 K. For the UV-illuminated sample, the temperature-independent $1/T_1$ of $\sim 0.3 \text{ s}^{-1}$ is also observed at temperatures below 200 K, indicating an increase in $1/T_1$ by UV illumination. There are two possible origins for the increase in $1/T_1$: one is the generation of color centers and the other is the enhancement of the interaction between dilute paramagnetic moments and photocarriers. Furthermore, we found that $1/T_1$ increases with increasing temperature only for the UV-illuminated sample at temperatures above 200 K; this implies a change in the nuclear magnetic field due to hydrogen dynamics. These results suggest that the hydrogen dynamics are thermally activated and a change of the local environment around hydrogen under UV illumination.

References:

- [1] Li et al., Phys. Status Solidi B 249, 1861 (2012).
- [2] Komatsu et al., Chem. Mater. 34, 3616 (2022).
- [3] Hayashi et al., Nature 419, 462 (2002).

Primary author: KOMATSU, Yuya (Tokyo Tech)

Co-authors: Dr SHIMIZU, Ryota (Tokyo Tech); Prof. HITOSUGI, Taro (Univ. Tokyo; Tokyo Tech); Dr SATO, Ryuhei (Tohoku Univ.); Prof. WILDE, Markus (IIS Univ. Tokyo); Prof. FUKUTANI, Katsuyuki (IIS Univ. Tokyo; JAEA); Prof. TSUNEYUKI, Shinji (Univ. Tokyo); TICKNOR, John O. (UBC); Dr FUJIMOTO, Derek (UBC); ADELMAN, Jonah R. (UBC); Dr MCFADDEN, Ryan M. L. (UBC); Dr MCKENZIE, Iain (Simon Fraser Univ.; TRIUMF); Dr STACHURA, Monica (TRIUMF); Dr MORRIS, Gerald D. (TRIUMF); Prof. MACFARLANE, W. Andrew (UBC); Dr SUGIYAMA, Jun (CROSS Neutron Science and Technology Center)

Presenter: KOMATSU, Yuya (Tokyo Tech)

Session Classification: Posters

Track Classification: Semiconductors