MBE 法を用いた $LiTi_2O_4$ エピタキシャル薄膜及びスピンフィルター接合の作製

高城拓也、*長浜太郎、*島田敏宏
（北海道大学大学院総合化学院、*北海道大学工学研究院）

Fabrication of $LiTi_2O_4$ epitaxial films and spin-filter junctions by MBE

T.Takagi, *T.Nagahama, *T.Shimada
(Grad. Sch. of Che. and Eng., Hokkaido Univ. *Grad. Sch. of Eng., Hokkaido Univ.)

【Introduction】

In recent electrical device industry, spintronics is a crucial technique which develops the memory technology from volatile to non-volatile. In the research field, high functional materials are required to realize novel spintronic devices. For example, Fe_3O_4 are predicted as half metal, that have 100% of spin polarization, and $CoFe_2O_4$ is expected to be spin filter tunnel barrier. These oxides have spinel structure, so that spinel oxides are considered to be important materials. From the viewpoints of the epitaxial growth, the conductive spinel materials are suitable as the electrodes, although Pt has been used as the electrode in the spinel spintoronic devices. If the materials with spinel structure are used as the electrodes, significant improvement in the magnetotransport properties is expected. $LiTi_2O_4$ are reported as an electrically conductive oxide with a spinel structure. Recently, Chopdekar et al. [1] and Kumatani et al. [2] succeeded in the fabrication of the epitaxial $LiTi_2O_4$ thin films by PLD method. In this study, we fabricated high-quality $LiTi_2O_4$ epitaxial films and spin-filter junctions by molecular beam epitaxy (MBE) and examined transport properties.

【Experiments】

Films were fabricated by an MBE system. The first sample structures were $Al_2O_3(0001)/LiTi_2O_4$. $LiTi_2O_4$ thin films were formed by reactive deposition at 300℃ in an O_2 atmosphere, and then were annealed for 30 minutes in vacuum. The second sample structures were $Al_2O_3(0001)/LiTi_2O_4/CoFe_2O_4/Al_2O_3$ /Co/Au spin-filter tunnel junctions. $CoFe_2O_4$ layer were formed on $LiTi_2O_4$ thin films by reactive deposition at 300℃ in an O_2 atmosphere. Al_2O_3 layer were deposited at R.T. in an O_2 atmosphere. Co and Au layer were deposited at R.T. in Vacuum. Partial pressure of O_2 was 4.0×10^{-4} Pa. The epitaxial growth and the surface structure were observed by RHEED and AFM.

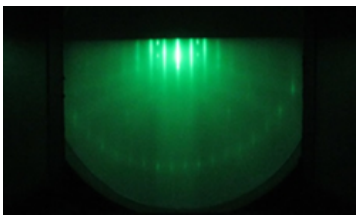

Fig.1 RHEED pattern of $LiTi_2O_4$ (60nm)

【Results】

Fig.1 shows the RHEED pattern of $LiTi_2O_4$ grown on $Al_2O_3(0001)$ at 300℃ and annealed at 700℃. The clear streak pattern was observed. From the AFM measurements, the surface roughness Ra was estimated at 0.23 nm. These results indicated that $LiTi_2O_4$ was flat epitaxial film. Fig. 2 shows MOKE hysteresis loop of Al_2O_3 (0001) /$LiTi_2O_4/CoFe_2O_4$. This figure indicated that $CoFe_2O_4$ on $LiTi_2O_4$ thin films shows good magnetic property. On the presentation, we will discuss about the tunneling properties.

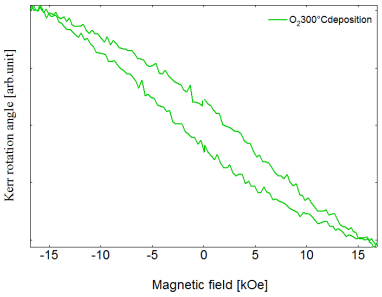

Fig.2 MOKE hysteresis loop of $CoFe_2O_4$ (10nm) on $LiTi_2O_4$ thin film.

【References】

1) R.V. Chopdekar et al, Physica C 469 1885-1891 (2009)
2) A. Kumatani et al, Appl. Phys. Lett. 101, 123103 (2012)