CdO is a II-VI semiconductor material with a band gap of 2.3 eV. Since CdO has a high mobility, it is possible to realize low resistive thin films even at low carrier concentration that can prevent free carrier absorption and a plasma reflection, leading to a high transparency in long wavelength region up to infrared [1]. Although the band gap of CdO is small as a transparent conductive oxide (TCO), it can be expanded by alloying with ZnO which has a band gap of ~3.3 eV. However, because ZnO has a wurtzite structure (a=3.25 Å, c=5.21 Å) whereas CdO a rocksalt structure (a=4.70 Å), the crystal structure of Zn1ₓCdₓO (ZnCdO) is expected to change at a certain Cd composition. The ZnCdO films deposited on soda lime glass substrates using a dual cathode pulsed filtered cathodic arc deposition showed the phase transition at x~0.7 and the largest optical band gap of 2.8 eV in the rocksalt ZnCdO film with a high mobility [2]. By using a nonequilibrium growth technique such as molecular beam epitaxy (MBE), the phase transition composition may be extended to a lower Cd composition ratio, which results in the expansion of the band gap. In addition, the use of the substrate with a rocksalt structure will be effective to obtain rocksalt ZnCdO films. Here, we report the growth of ZnCdO thin films by MBE on sapphire and rocksalt MgO substrates in order to realize rocksalt ZnCdO films suitable for TCO.

The band gap was determined by a square plot of absorption coefficient (α) obtained from transmittance and reflectance measurements. Figure 1 shows the variation of the optical band gap of ZnCdO films on sapphire substrates as a function of Cd composition. The band gap of ZnCdO changes largely at x~0.5, indicating the phase transition from wurtzite to rocksalt structure. The largest band gap of rocksalt ZnCdO is 2.95 eV. Figure 2 shows the electrical properties of ZnCdO on sapphire substrates determined by Hall measurements. The rocksalt ZnCdO showed a low resistivity of the order of 10⁻⁴ Ωcm with maximum mobility of ~90 cm²/Vs. These properties are suitable for the application of TCO. The phase transition composition was shifted to a lower Cd composition side by using MgO substrate.