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13-17 September 2021
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GROM / Thin films growth and modelling

Epitaxial growth of $(ZnO)_X(InN)_{1-X}$ films by magnetron sputtering: effects of surface polarity of ZnO substrates

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Abstract content

We have recently developed novel semiconductors, $(ZnO)_x(InN)_{1-x}$ (called "ZION" hereinafter), which are pseudo-binary alloys of ZnO and InN. ZION have high exciton binding energy of 30–60 meV making ZION promising materials for various kinds of optoelectronic devices[1,2]. Here, we demonstrate epitaxial growth of ZION films on ZnO substrates by magnetron sputtering. Since substrate surface polarity often affects the film growth[3], we prepare ZION films on both Zn- and O-polar ZnO substrates and discuss the effects on the film quality.
ZION films were deposited on Zn- and O-polar ZnO substrates by radio-frequency magnetron sputtering. O_2, N_2 and Ar gases were used. The total pressure was 0.50 Pa. ZnO and In targets were used. The substrate temperature was 450°C.
High-resolution TEM images show that the heteroepitaxial growth of ZION films with atomically sharp interfaces on both Zn- and O-polar ZnO surfaces, however, a significant difference in the lattice relaxation process between the films is also observed. Figure 1 shows distance between Zn or In atoms as a function of ZION film thickness. On Zn-polar ZnO surfaces, relaxation occurs at the beginning of the film growth, whereas on O-polar surfaces, the ZION films are fully coherent with the 1.6%-lattice-mismatched ZnO substrates at least for 15 mono layers. The differences in the film quality are probably attributable to differences in the surface migration of Zn/In atoms between on Zn- and O-polar surfaces.

Thanks/Acknowledgement
This work was supported by JSPS KAKENHI JP18H01206, JP19K21978, NTT collaborative research, and Samco Science and Technology Foundation.

References
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Fig. 1. Cation-cation distance along the a-axis as