

Characteristics of dislocations in ZnO layers grown by plasma-assisted molecular beam epitaxy under different Zn/O flux ratios

Agus Setiawan*, Zahra Vashaei, Meoung Whan Cho, and Takafumi Yao^{a)}
Center for Interdisciplinary Research, Tohoku University, Aramaki, Aoba-ku, Sendai, 980-8578, Japan

Hiroyuki Kato, Michihiro Sano, and Kazuhiro Miyamoto
Research & Development Center, Stanley Electric Co., Ltd., 1-3-1 Eda-Nishi, Aoba-ku, Yokohama 225-0014, Japan

I. Yonenaga
Institute for Materials Research, Tohoku University, 2-1-1 Katahira, Aobaku, Sendai 980-8577, Japan

Hang Ju Ko
Korea Photonics Technology Institute, 459-3 Bonchon-dong, Buk-gu, Gwangju 500-210, South Korea

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We have investigated the characteristic of the dislocations in the ZnO layers grown on *c* sapphire by the plasma-assisted molecular beam epitaxy under the different Zn/O flux ratios. The ZnO layers were characterized by the transmission electron microscopy (TEM) and the high-resolution x-ray diffraction (HRXRD). The TEM and HRXRD experiments revealed that the major threading dislocations (TDs) in the ZnO layers are the edge dislocations running along the *c* axis with Burgers vector of $1/3k11-20l$. The TD densities are determined to be 6.93109 , 2.83109 , and 2.73109 cm^{-2} , for O-rich, stoichiometric, and Zn-rich grown ZnO, respectively. Different from the O-rich grown ZnO where the dislocations run along the *c*-axis, several dislocations in the stoichiometric and the Zn-rich grown ZnO are inclined to $20^\circ, 30^\circ$ from the *c*-axis. By considering the slip system in the wurtzite-structure ZnO, the glide planes of the dislocations are close to $s10-10d$ for the O-rich grown ZnO and close to $s10-11d$ for the stoichiometric and Zn-rich grown ZnO. Furthermore, the thickness of the interface dislocations in the O-rich grown ZnO is much thinner than in the stoichiometric and Zn-rich grown ZnO. In addition, the most probable origin of the inclined dislocations including *c/a* ratios, growth rate, and initial growth stage of high temperature sHTd-ZnO layers are also discussed. © 2004 American Institute of Physics.

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*Permanent address: Department of Mechanical Engineering Education, Indonesia University of Education, Jl. Dr. Setiabudhi 207 Bandung, Indonesia