ZnO thin film co-doped with boron and fluorine for transparent conducting oxide electrode applications

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Transparent conductive oxides have been used for the electrodes. New TCO materials are needed as a replacement for indium, which is scarce and costly. One such material is ZnO. When group Ⅲ oxides (In_2O_3, Al_2O_3, and B_2O_3) are substituted for the Zn lattice site, the dopant atoms generate the additional electron. We studied the performance of boron-doped ZnO and reported that $Zn_{0.98}B_{0.02}O$ thin film has good electrical and optical properties. We also observed that there was no further decrease of resistivity above a certain doping level of boron (2 at%) because of the electron scattering effect .There is less electron scattering if the dopant atoms are a substitute for oxygen atoms in the ZnO lattice rather than in the Zn site. Fluorine atoms are halogen atoms that correspond in size to oxygen atoms, and the size correspondence makes them ideal substitutes for oxygen atoms. For this study, we fabricated $Zn_{0.98}B_{0.02}O_{1-y}F_y$ films on glass substrates by using liquid source misted chemical vapor deposition (LSMCD) at room temperature. The focus of our analysis is on the crystalline structure and the optical and electrical properties of boron and fluorine co-doped ZnO.