論文 / 著書情報
Article / Book Information

題目(和文)	表面修飾ポリマー基板上におけるZnO薄膜の結晶成長と物性に関する研究
Title(English)	Study on crystal growth and properties of ZnO thin films on surface-modified polymer substrates
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学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	材料 系 材料 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of （ 工学 ）
学生氏名： Student's Name	大賀 友瑛	指導教員（主）： Academic Supervisor(main)	吉本 護
		指導教員（副）： Academic Supervisor(sub)	松田 晃史

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In this thesis, the crystal growth and properties of ZnO thin films on surface-modified polymer substrates were investigated. This thesis consists of seven chapters written in English.

In chapter 1, the background and objective of this thesis were described in the general introduction. Materials for flexible devices, the effect of surface modification of polymer substrates, crystal growth of oxide thin films on polymer substrates, and ZnO thin films on various substrates are described. Crystal orientated growth is important for the formation of oxide semiconductor devices to control their physical properties. Nucleation and growth orientation control techniques at low temperatures are required on polymer substrates, and effect of surface modification of polymer substrate on of crystal growth of ZnO thin films is expected. The objective of this thesis is to clarify the effect of physical and chemical surface modification of polymer substrates on the crystal growth of ZnO thin films on polymer substrates, which affects the crystallinity and orientation, and to verify the surface modifying conditions for the preparation of ZnO thin films with high crystallinity and orientation to achieve high electrical and optical properties.

In chapter 2, polymer surface modification, ZnO thin film preparation, and sample evaluation techniques were presented.

In chapter 3, the crystal growth and properties of ZnO thin films grown on the surface flatness improved polymer substrates by thermal nanoimprinting was investigated. The ZnO thin film was grown on cyclo-olefin polymer (COP) substrate with an ultra-flat surface on which an atomic step pattern was transcribed by thermal nanoimprinting. The ZnO thin film on surface flatness improved polymer substrate was improved surface flatness and orientation, reflecting the substrate surface topography. Crystallinity was also slightly improved. This resulted in a slight improvement in visible light transmission and resistivity.

In chapter 4, the crystal growth and properties of ZnO thin films on polymer substrates whose surface flatness was improved, and chemical state was modified by vacuum ultraviolet light irradiation were investigated. The ZnO thin films grown on COP substrates pretreated by vacuum ultraviolet (VUV) light irradiation not only improved the surface flatness and orientation, but also improved the crystallinity. This resulted in the electrical resistivity of the ZnO thin film was reduced by about 40%, indicating that the improvement of the crystallinity of the ZnO thin film by the chemical modification of the polymer substrate contributed greatly.

In chapter 5, the crystal growth and properties of ZnO thin films grown on oxide buffered polymer substrates was investigated. The ZnO thin films were grown on a polymer substrate with amorphous, polycrystal and single crystal buffer layer insertion. The crystal growth of c-axis oriented ZnO thin films enhanced on amorphous oxide buffers, while scattered on randomly oriented and crystallized oxide buffers. The ZnO thin film on β-Ga_2O_3 single-crystal buffered COP substrates was epitaxially grown. The electrical resistivity of the ZnO thin film grown on the amorphous AlO_x buffered COP substrate was 34% smaller than that of the films grown on the untreated substrates, and the resistivity of ZnO thin film grown on β-Ga_2O_3 single-crystal buffered COP substrate was the lowest resistivity on polymer substrate in this study.

In chapter 6, the crystal growth and properties of ZnO thin films grown on surface modified COP substrates with a combination of physical and chemical surface modification was investigated. The combination of physical and chemical surface modification techniques was performed by thermal nanoimprinting and oxide buffer insertion. The ZnO thin film grown on the nanoimprinted and AlOx buffered COP substrates was ultra-flat surface with a root-means-square roughness of 0.2 nm on a 3 μm square and c-axis oriented growth with clear orientation and crystallinity improvement. The combination of physical and chemical surface modification techniques using thermal nanoimprinting and oxide buffer insertion has resulted in more effective crystal growth and flatness of ZnO thin films. Al-doped ZnO (AZO) thin films were also prepared on these surface-modified polymer substrate. The AZO thin films on surface flatness improved and AlO_x buffered COP substrates exhibited a surface RMS roughness of about 0.5 nm at 3 μm square, a resistivity of 2.8×10^{-4} Ωcm, and a transmittance in the visible light region of about 90% or more. These were achieved by the growth of highly crystalline and oriented ZnO thin films on the surface-modified polymer substrate.

In chapter 7, the results and knowledge of this study were summarized. Through the results of the above chapters, the effects of various surface modifications of on polymer substrates on the crystal growth of ZnO thin films were clarified. This knowledge of the effect of surface modification of polymer substrates on the crystal growth and properties of ZnO thin

films in this study are expected to improve the of device performance using ZnO thin films on polymer substrate and contribute to further flexible device development.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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