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アモルファス InGaZnO4 薄膜表面における 1 本鎖 DNA 分子の固定

Immobilizations of single-stranded DNA molecules onto amorphous InGaZnO4 film surfaces

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Amorphous indium gallium zinc oxide (aIGZO) has been vastly industrialized as a key component for transparent Thin Film Transistor (TFT). However, no research has been found yet applying aIGZO to biosensing. This paper examined the single strand DNA (ssDNA) immobilization on aIGZO by absorption with a comparison to ITO, which is the first step for many biosensing schemas.

In this work, ssDNA is immobilized using the physical absorption process proposed by Xu et al. including OH^- and APS treatment, for DNA immobilization on aIGZO film surfaces. To quantify DNA immobilization efficiency on aIGZO film surfaces, fluorescence label (FAM) marking ssDNA was selected, collaborating with AFM observations of the surface morphologies in the meantime. The aIGZO and ITO films were fabricated by rf magneto sputtering, and were confirmed by XRD with annealing before use.

By examining the fluorescence images after ssDNA immobilization on aIGZO and ITO films, the fluorescence intensity shows its dependency to ssDNA solution concentration used for immobilization.

The DNA quantification by fitting to Langmuir model from florescence intensity shows that the absorption capacity of aIGZO film to ssDNA is 3.5 times greater than that of ITO (Fig.1).

Because the rest of the conditions: APS and ssDNA concentration, processing steps were identical for the immolizations on aIGZO and ITO, the only possible explanation for the higher ssDNA absorption capacity on aIGZO film is that less OH^- group was immoblized on ITO surface than aIGZO.

To quantify the effectiveness of OH^- treatment, the peak area ratio γ is defined for XPS spectrum: $\gamma = \frac{A_{OH^-}}{A_{O^{2-}}}$, where A_{OH^-} is the peak area of OH^-, $A_{O^{2-}}$ the peak area of O^{2-}. The rate of change, indicating OH^- treatment effectiveness is defined as: $\Delta\gamma = \frac{\gamma \text{ with } OH^- \text{ treatment}}{\gamma \text{ as deposited}}$. As shown in Fig. 2, the $\Delta\gamma$ value of the aIGZO film is 10 times more than that of the ITO film. This result is accordant with the maximum absorption capacity result shown in Fig. 1

A feasible method to immobilized ssDNA on aIGZO thin film is evaluated in this paper, and consequently, enables a possible approach to apply aIGZO in biosensing.

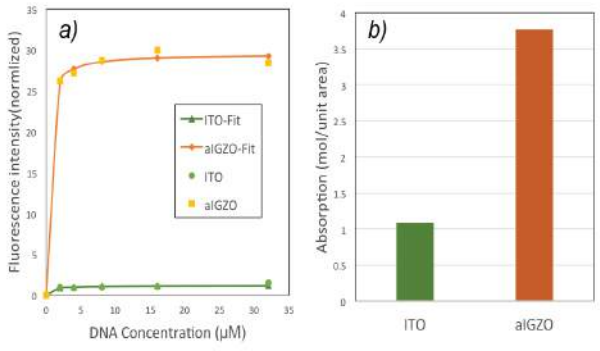

Fig. 1 Model fitting of the fluorescence labeled ssDNA immobilization. a) Curve fitting plot. b) Maximum absorption capacity of aIGZO and ITO film.

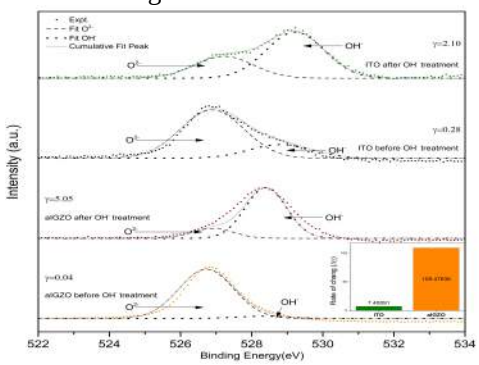

Fig. 2 High resolution O 1s XPS spectra and peak convolution of aIGZO and ITO film with and without OH^- pretreatment. The inset shows the rate of change on $OH^-/O2^-$ peak area ratios before and after OH-treatment.