Novel optically-rough and physically-flat Zn$_{1-x}$Mg$_x$O: Al substrate for superstrate-type thin-film solar cells

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Novel optically-rough and physically-flat (OR-PF) Zn$_{1-x}$Mg$_x$O:Al thin film substrate was developed for superstrate-type thin-film solar cells. It was fabricated by spin-coating sol-gel Al doped Zn$_{1-x}$Mg$_x$O (AZMO) thin film on roughened glass substrate with a two-dimensional grating structure. Uniform and periodic feature size was formed on the glass substrate by using room-temperature nanoimprinting technique. Effect of shape and period of feature size on the optical properties of OR-PF AZMO substrate was investigated. It was applied as the front electrode of hydrogenated amorphous silicon (a-Si:H) single junction solar cells. Figure 1 shows the SEM micrographs of glass substrate imprinted with hole pattern (Period (P) =1.7 µm) and OR-PF AZMO/hole patterned glass substrate. The AZMO/hole (P=1.7 µm) patterned substrate shows low optical absorption, an average haze ratio in transmission of 13.1 % at wavelength region of 700-850 nm, a low surface roughness, and a sheet resistance of 62.7 Ω/sq. These results suggest the potential of this OR-PF AZMO substrate for the front electrode of superstrate-type thin-film solar cells.

Fig.1 (a) SEM micrograph of the surface of the glass substrate imprinted with hole pattern (P=1.7 µm) and (b) SEM micrograph of the cross section of the OR-PF AZMO/hole (P=1.7 µm) patterned glass substrate.

[Acknowledgment]
This work was supported by JSPS KAKENHI Grant Number 26709075.