# ALD-AlO$_x$ 電界効果を利用した PEDOT:PSS/n-Si 接合太陽電池

## PEDOT:PSS/n-Si heterojunction solar cells with ALD-$Al_2O_3$/n-Si field effect inversion layer

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**1. INTRODUCTION:** In this paper, we present the termination of atomic-layer-deposited (ALD)-$Al_2O_3$ on c-Si by UV photolithography process and the effect on the performance of PEDOT:PSS/n-Si solar cells. Since PEDOT:PSS is a transparent hole-conducting layer with higher Si passivation ability, the PEDOT:PSS/n-Si junction acts as a solar cell with no use of additional step. However, for further strengthen the electric field, passivation quality, improvement of the chemical stability of the interface, and the minimize of the contact area between Si and PEDOT:PSS is a possible candidate using a high-dielectric such as $Al_2O_3$. In this study, we present the effect of inversion layer of ALD-$Al_2O_3$/n-Si on the passivation of n-Si and field effect at PEDOT:PSS/n-Si interface.

**2. EXPERIMENTAL PROCEDURE:** A ~25-nm-thick $Al_2O_3$ layer was formed on cleaned 1×1 cm$^2$ sized n-Si (1-5 Ω·cm) by TMA + $H_2O$ ALD method followed by heat treated at 425°C for 15 min. After that, the 15×15 μm$^2$ area of $Al_2O_3$ was etched out locally with 50μm intervals by photolithography process. After then, the etched ALD-$Al_2O_3$ was post annealed at 425°C for 15 min to recover its minority carrier lifetime. Thereafter, a ~70-nm-thick PEDOT:PSS was spin coated, followed by thermal annealing at 140°C for 30 min. An Ag grid electrode was provided as a top electrode, and InGa as a rear electrode. Evaluation was performed by microscope, SEM, ellipsometry, micro PCD, *C*-V, and *J*-V characteristics.

**3. RESULTS:** Fig. 1 shows a cross-sectional SEM image of 15 μm □, 50 μm gap ($Al_2O_3$: PEDOT:PSS area ratio = 3.3: 1) formed on the ALD-$Al_2O_3$ layer. In Fig. 2, minority carrier lifetime study after etched ALD-$Al_2O_3$ using UV photolithography process to recover the lifetime as same as before etching ALD- $Al_2O_3$. Also, the built-in-voltage determined from *C*-V characteristics designed at different intervals increased from 750 mV to 760 mV (50 μm), 780 mV (100 μm), 820 mV (150 μm) only from PEDOT:PSS. I will present the effect of inversion layer of ALD-$Al_2O_3$/n-Si on passivation quality and the performance for the device using photolithography process.

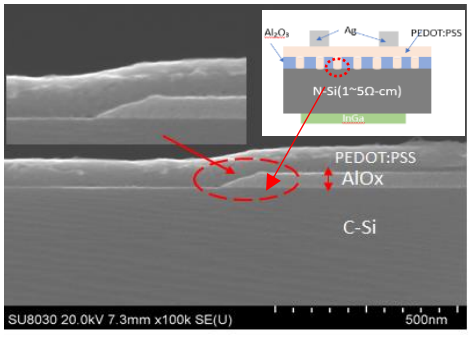


**Fig. 1** Cross-sectional image of etched ALD-$Al_2O_3$/ PEDOT:PSS/n-Si fabricated

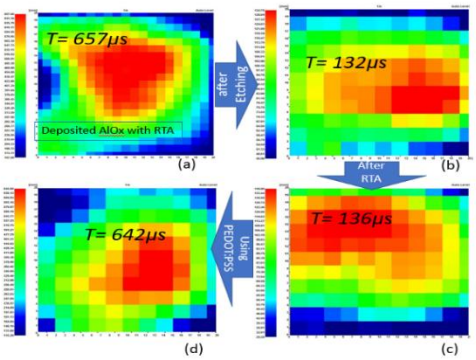


**Fig.2** Minority carrier lifetime of ALD-$Al_2O_3$/n-Si before and after etching $Al_2O_3$ using UV photolithography process.