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Rapid Thermal Annealing Effect on Electric and Optical Properties of Room-Temperature-Deposited ITO Film

Object: To study electric and optical property changes of room-temperature-deposited ITO film, after rapid thermal annealing (RTA) which are due to the phase-transition from amorphous to polycrystalline.

Samples: Si, SiNx (240 nm, n=1.960 at 632.8 nm)/ Si, and silica pieces.

Film Deposition at Room Temperature: Mounting these samples onto the room-temperature chuck of E-beam#2, setting the Tooling Factor as 131.5, Chamber base pressure was 7.5e-6 Torr and the working pressure during the deposition was between 3.70 and 2.95e-5 Torr. The target film thickness was set to 2000Å, and the deposition rate was ~1Å/s.

Film Sheet Resistance: Measured by 4-probe method.

Film Transmission Spectra: Were measured using Cary 500 Scan UV-VIS-NIR Spectrophotometer.

Film Rapid-Thermal-Annealing: Was done with an annealing temperature of 350 ^{o}C for 60 minutes in an environment of nitrogen gas-flow-rate of 0.5 slm.

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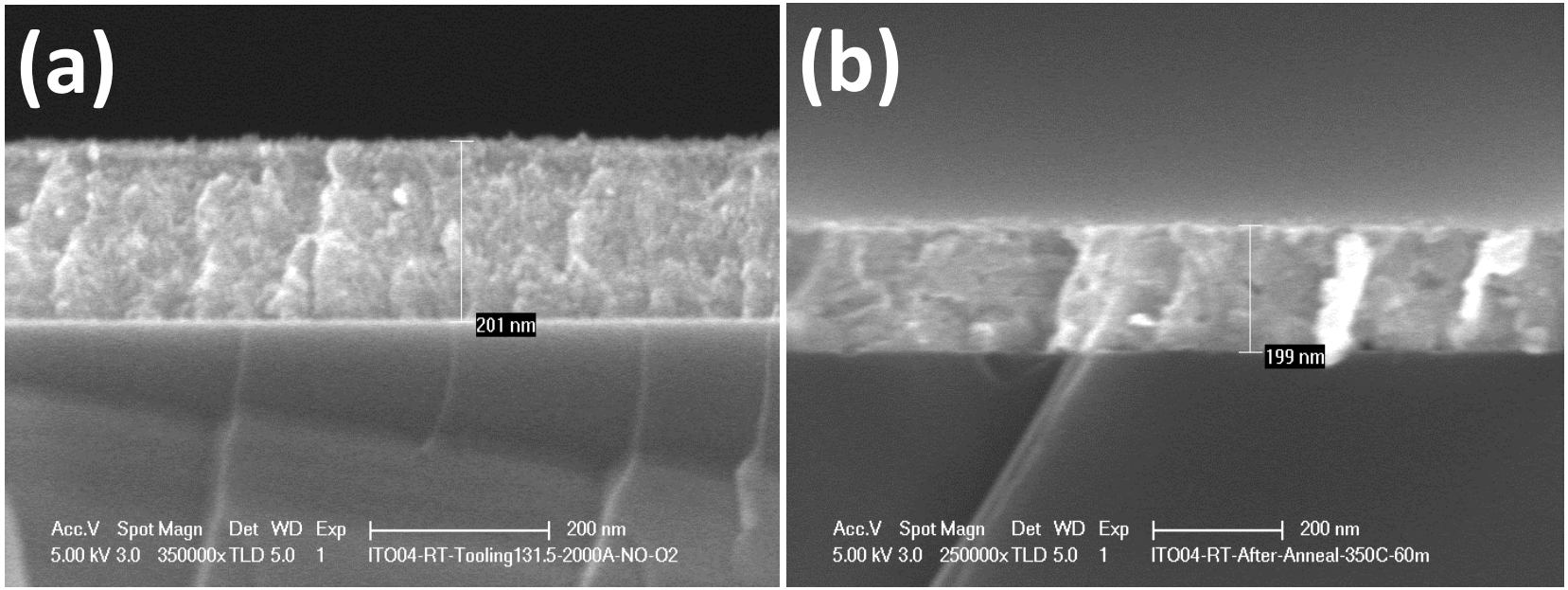
Results:

1. Film profile before and after RTA at 350°C for 60 minutes in an environment of nitrogen gas flow (0.5 slm).

Figure 1 SEMs show the ITO film profile: (a) Before RTA; (b) After RTA at 350°C for 60 minutes.



2. Sheet resistance of ITO film before and after RTA at 350 C for 60 minutes in an environment of nitrogen gas flow (0.5 slm).

Before RTA: 2035 Ω/sq (resistivity=2035x0.201x10^{-4}=4.09x10^{-2}Ωcm)

After RTA: 66.9 Ω/sq (resistivity=66.9x0.199x10^{-4}=1.33x10^{-3}Ωcm)

3. Transmission spectra of ITO film between 400 and 800 nm before and after RTA at 350^{o}C for 60 minutes in an environment of nitrogen gas flow (0.5 slm).

Figure 2 Transmission spectra of ITO film before and after the annealing

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