

FIG. 5: Ar-milling effect. (a) Thickness dependence (red solid squares) of room-temperature conductance of oxygen-annealed crystalline LAO/STO heterostructures fabricated at 10^{-3} Torr and 750°C , showing a critical thickness of 4 uc. The red hollow diamonds denote that the conductivity of the 4 uc sample disappears after the removal of the top 1 uc LAO by Ar-milling. Moreover, the blue hollow circles represent the conductance of an unannealed 10 uc crystalline LAO/STO heterostructure and after the removal of the top 8 uc LAO by Ar-milling. The black hollow stars represent the conductance of another oxygen-annealed 10 uc crystalline LAO/STO sample after step-by-step Ar milling. (b) Thickness dependence (green solid squares) of room-temperature conductance of amorphous LAO/STO heterostructures fabricated at 10^{-3} Torr, showing a critical thickness of 6 nm. The green hollow diamonds represent the conductivity of the 6 nm sample that remains after the removal of the top LAO layer 1 nm at a time by Ar-milling. All the arrows represent the Ar-milling process.

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$$\circ \text{ (diamond symbol)}$$

ex situ

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$$\sim 10^{13} \text{ m}^{-2} \text{ (carrier density)}$$

$$\sim \epsilon_r \epsilon_0 \text{ (dielectric constant)}$$

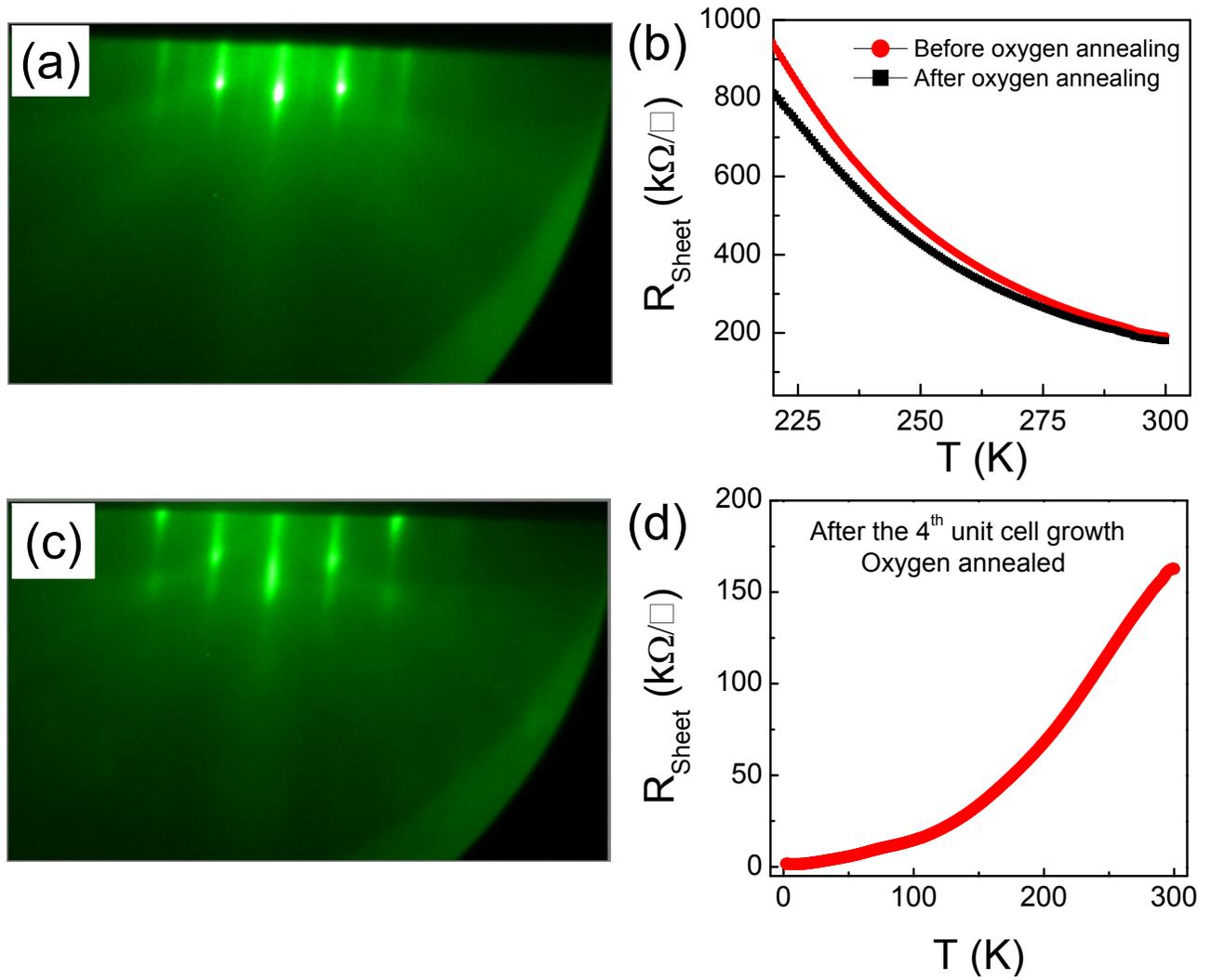


FIG. 6: Re-growth experiment. (a) Reflection high energy electron diffraction (RHEED) pattern after depositing a new LAO layer (estimated to be 2 uc) on a crystalline LAO/STO heterostructure with the LAO layer etched from 4 uc to 3 uc. (b) R_s - T curves of the re-grown sample stated in (a) before and after oxygen annealing. (c) RHEED pattern after depositing one uc LAO on an as-grown 3 uc crystalline LAO/STO heterostructure. (d) R_s - T curve of the re-grown sample described in (c) after oxygen annealing.

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