



Extraordinarily high conductivity at interfaces of ZrO₂:Y₂O₃/SrTiO₃ heterostructures: origin and perspective

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On the origin of the metallic conductivity at the interface of $\text{LaAlO}_3/\text{SrTiO}_3$

Y. Z. Chen, D. V. Christensen, F. Trier, N. Pryds, A. Smith, and S. Linderoth

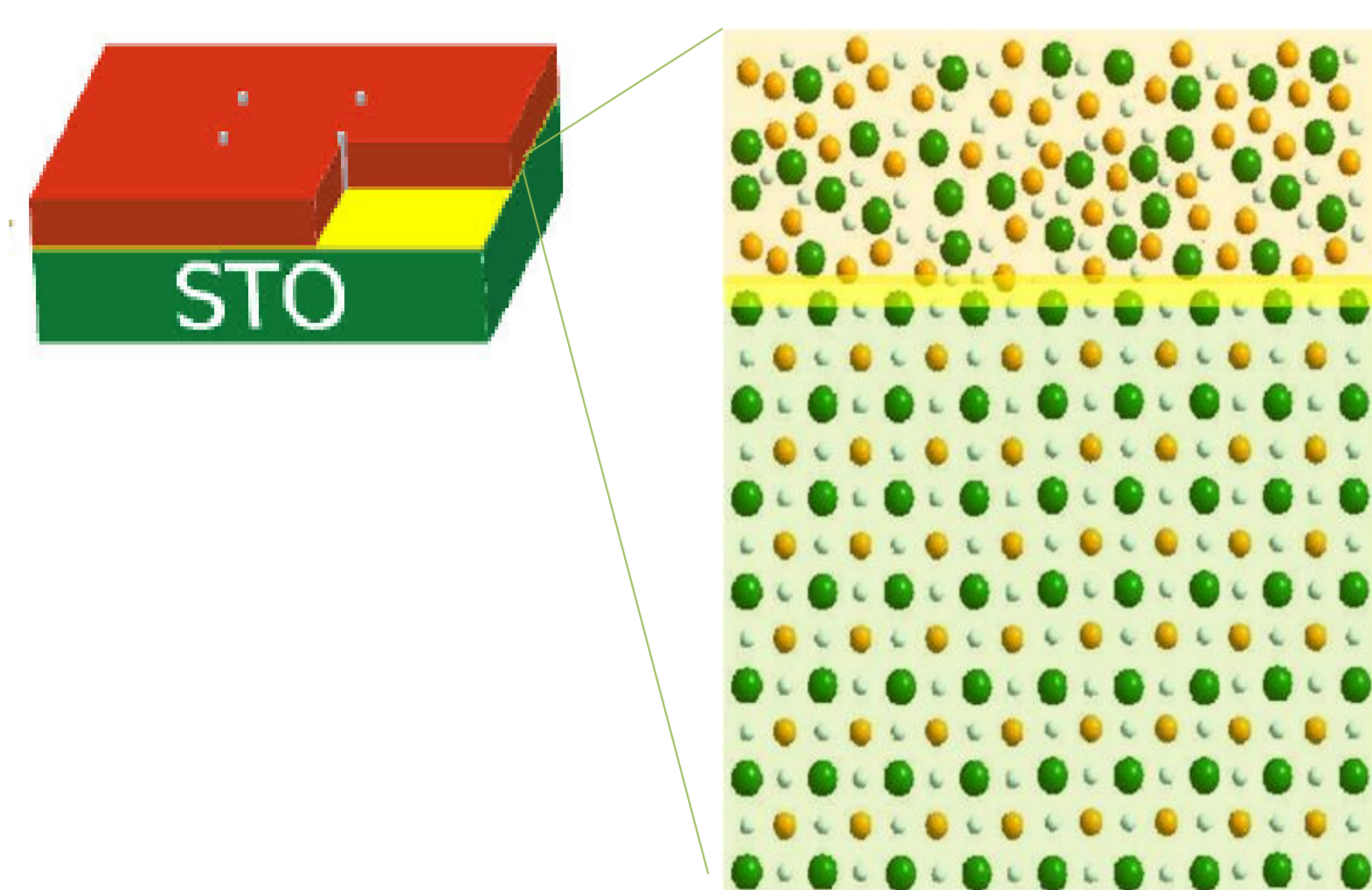
Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Technical University of Denmark, DK-4000 Roskilde, Denmark

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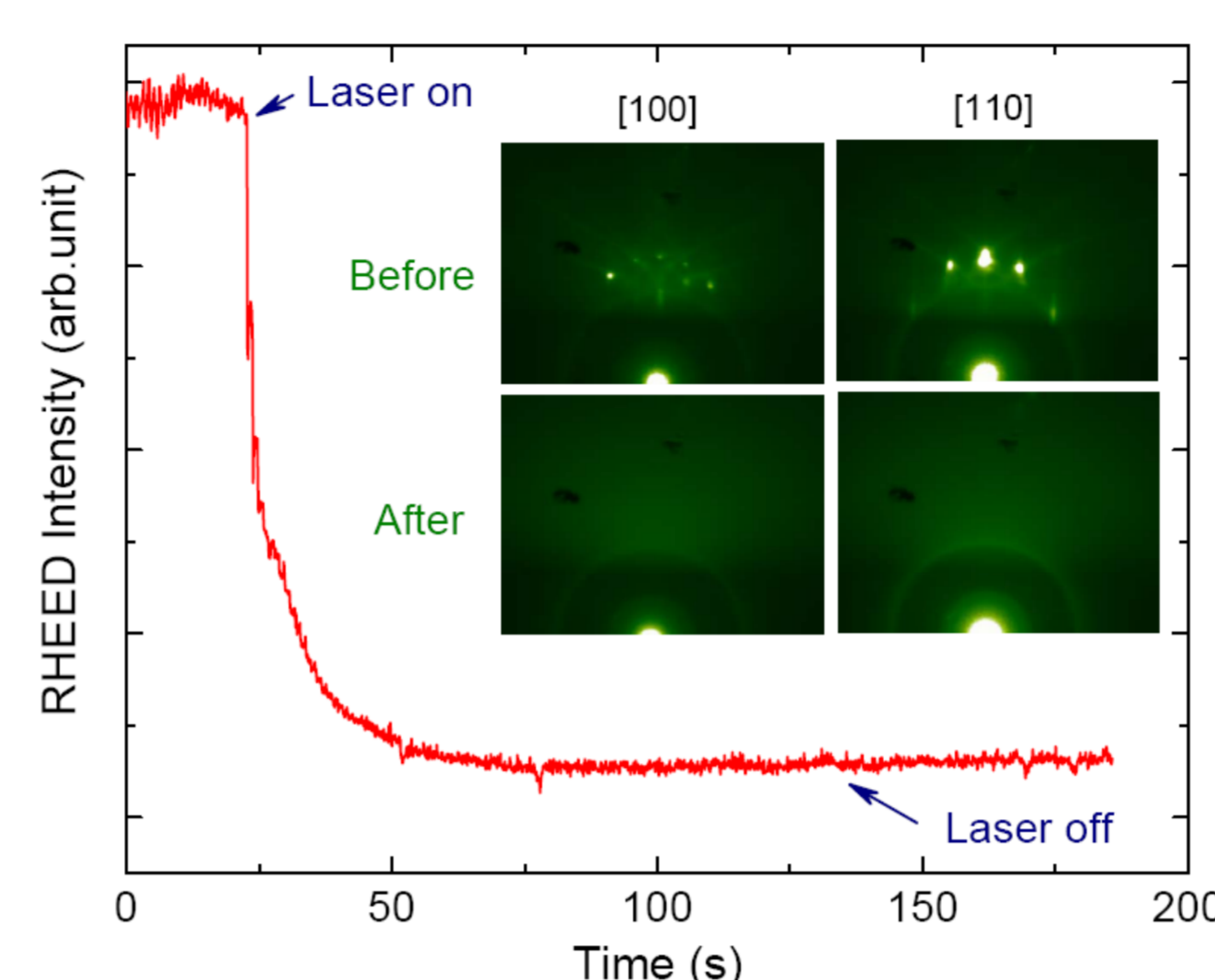
➤ Motivation:

- (1) The mechanism underlying the quasi-two-dimensional electron gas (q-2DEG) at the interface between two insulating oxides of LaAlO_3 (LAO) and SrTiO_3 (STO) remains unclear;
- (2) Whether the metallic conductivity exists in LAO/STO hetero-structures if the top LAO films are amorphous, where both polar discontinuity and cation intermixing at the interface are expected to be significantly suppressed.

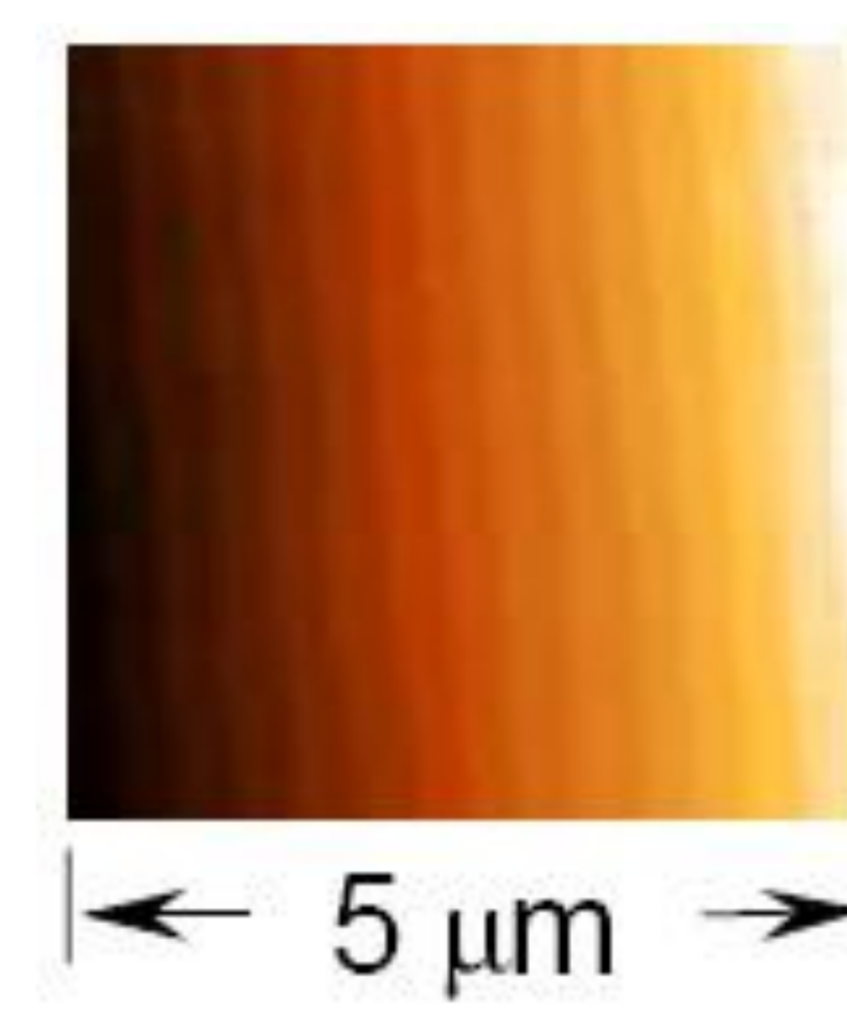
➤ Metallic and insulating interfaces in LAO/STO hetero-structures with amorphous over-layers



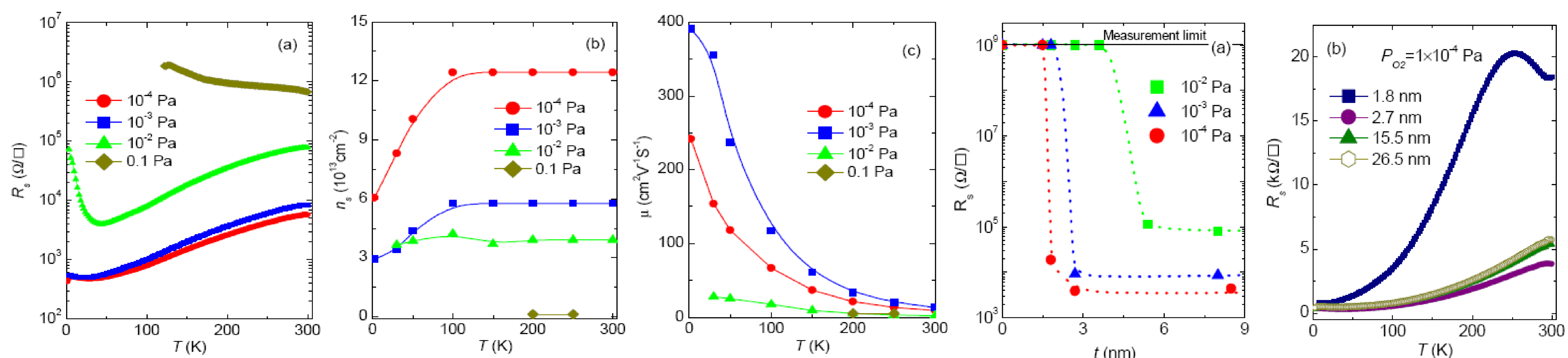
Sketch of the metallic interface



Film growth checked by RHEED

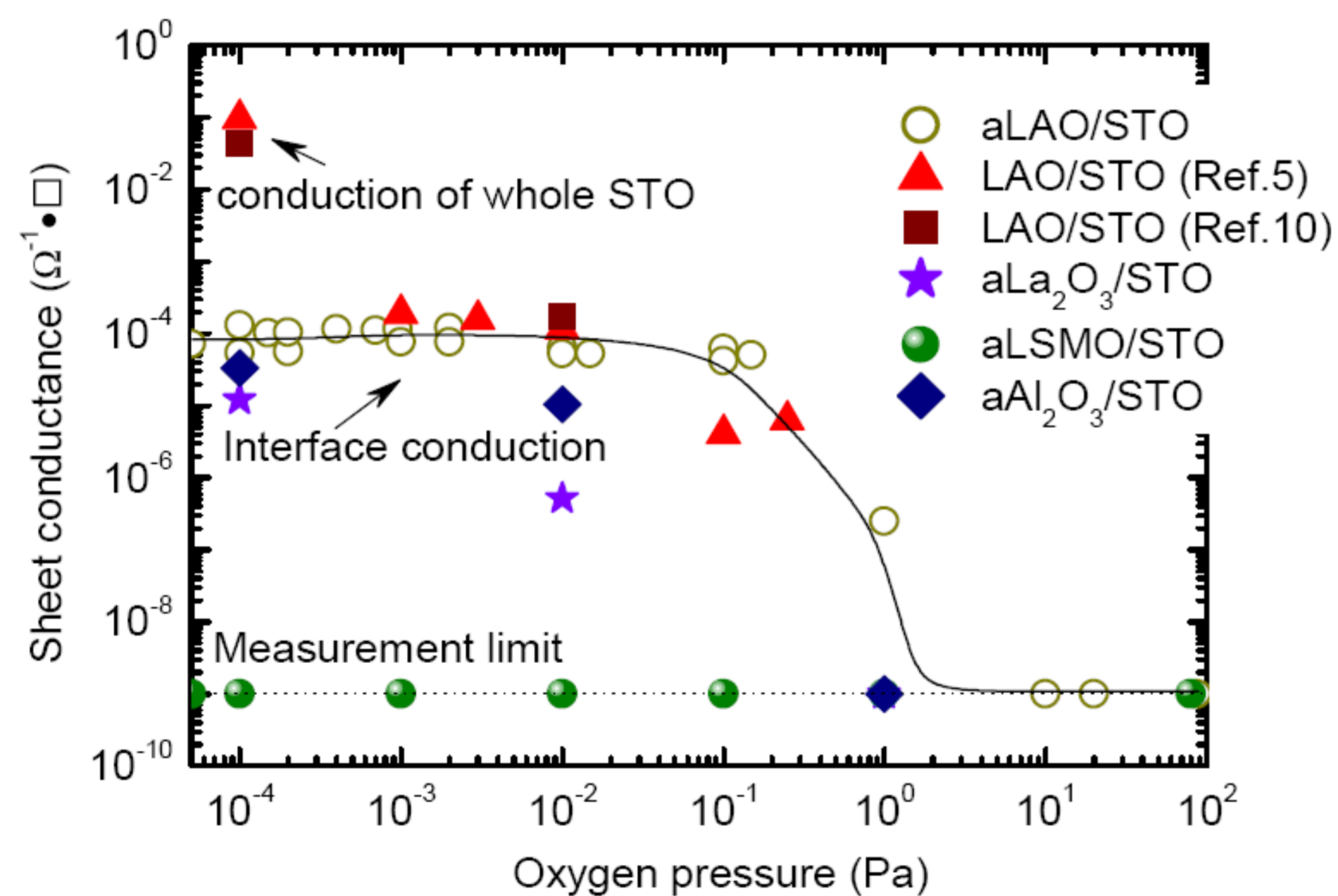


Smooth surface

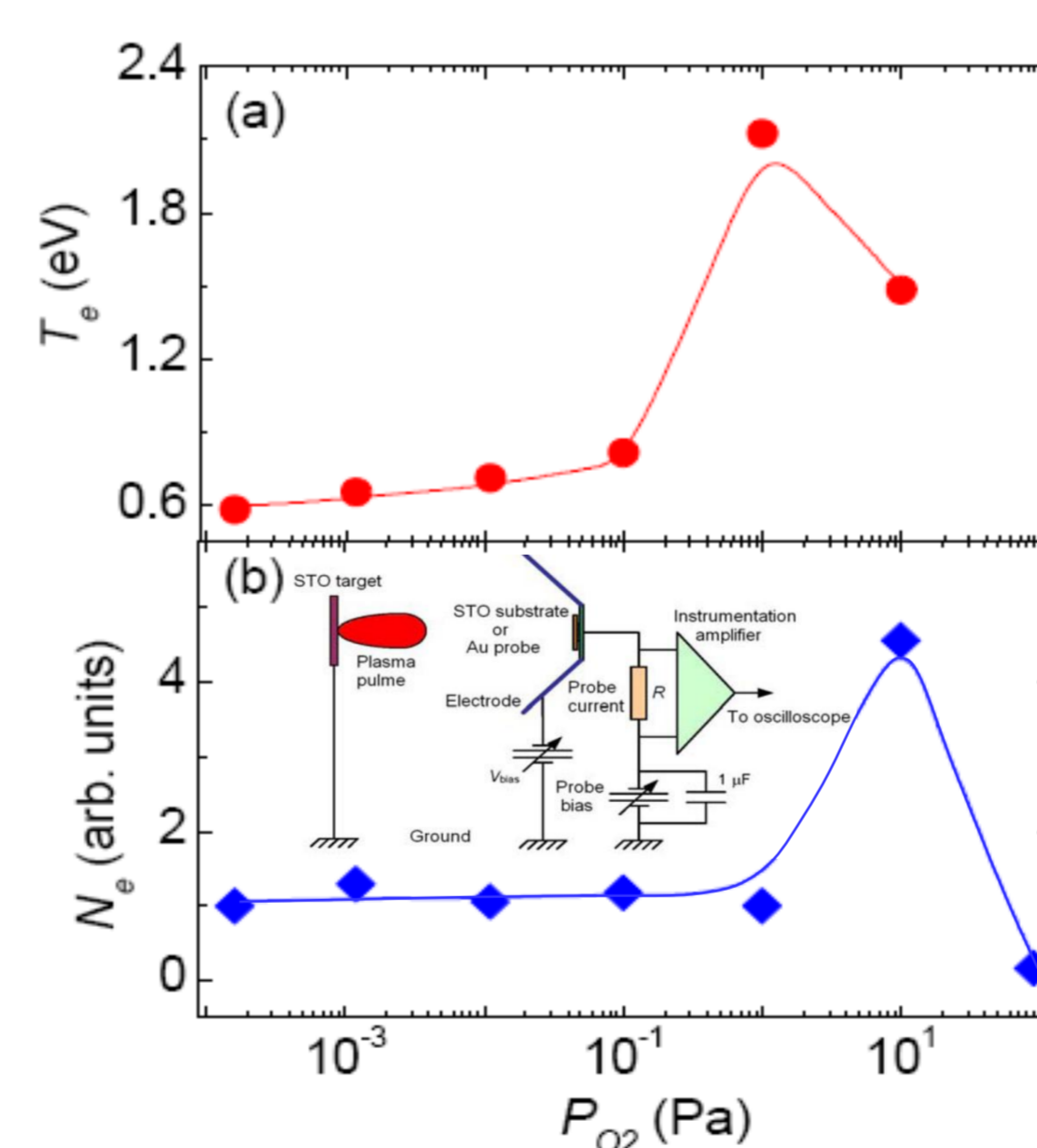


The dependence of the conductivity on the film thickness and oxygen pressure during film growth

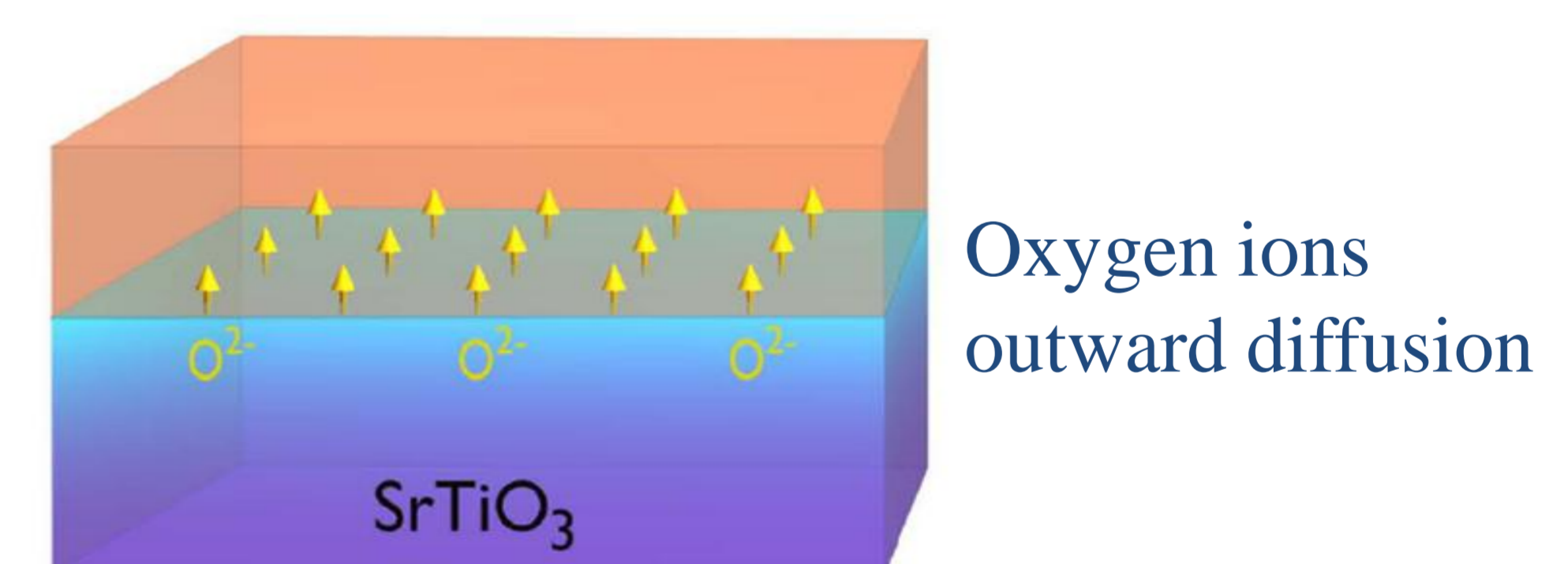
➤ Plasma composition related interfacial conductivity in STO-based oxide hetero-structures



Conductivity versus film composition



PLD plasma expansion dynamics



Redox reactions on STO surface

➤ Conclusion:

1. Metallic interfaces between the STO substrate and various insulating amorphous films of LAO, La_2O_3 , or Al_2O_3 .
2. Critical dependences of the conductivity on both film thickness and oxygen pressure during film growth.
3. Redox reactions on the STO substrate surface play an important role in determining the conductivity.

➤ Relevant papers

1. Y. Z. Chen *et al.* Metal-insulator transitions at interfaces of amorphous SrTiO_3 -based oxide hetero-structures (submitted).
2. Y. Z. Chen *et al.* Charge-modulated interfacial conductivities in SrTiO_3 -based oxide hetero-structures (submitted).