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Engineering Complex Oxide Interfaces – from Electronics to Energy Applications

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The rich physical and chemical properties found in complex oxides make them essential materials for electronic and energy harvesting devices. The capability to synthesize these oxides with atomic-scale precision has not only provided pathways to integrate their diverse physical properties at solid/solid interfaces, but also presents opportunities to engineer functionalities at solid/liquid (gas) interfaces for fuel cells and photocatalytic applications. A common challenge routinely faced in designing these functionalities is the control of carrier transport across solid/solid or solid/liquid (gas) interfaces without altering the bulk properties of the constituents. One powerful approach to overcome this challenge is to artificially shift the interface energy level alignments by formation of an electrostatic dipole. By exploiting the strong ionic nature and the flexibility to expose well-defined surfaces with varying chemical compositions in complex oxides, we have successfully modulated the interface barriers by as much as ~1 V, far surpassing those obtained in conventional systems. In this talk, I will introduce our developments toward engineering oxide interfaces including the control of macroscopic junction properties in Schottky junction geometry [1-3], its application to solid-state devices [4, 5], and how the same technique can be implemented to oxide/liquid interfaces for solar hydrogen generation [6].

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