Mesoscale Priority Research Direction

Mesoscale functionality from interface-dominated oxides

Opportunity

- **Controlled assembly of mesoscale heterostructures → Interface-dominated materials with new functionality not available in bulk.**
- **New materials: Multilayers composed of two or more dissimilar oxides.**
- **Emergent phenomena: Enhanced ionic and electronic conductivity, novel catalytic and ferroelectric behavior.**

Approach

- **Multilayer heterostructure synthesis allowing continuous modification of materials chemistry to engineer interface structure and properties.**
- **Utilize emerging techniques in atomic-scale and chemical analysis (TEM, AFM, etc).**
- **Electrical and electrochemical measurements integrated with modeling to determine optimal device composition and architecture.**

Meso Challenge

- **What is relationship between heterostructure parameters (e.g., geometry, composition) and target functionality?**
- **Incorporation into current energy and electronic technologies.**

References: R.A. De Souza et al., Energy Environ. Sci., 5, 5445 (2012)
E. Fabbri, et al., Sci. Tech. Adv. Mater., 11, 054503 (2010)

Impact

- **New functionality from engineered heterostructure → Transformational leap from conventional materials design approaches used in current energy technologies, e.g., fuel cells.**
- **Predictive capabilities to design functional materials from nanoscale up for other electrochemical devices, e.g., batteries and chemical sensors.**

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