MIP: PARADIM at Cornell University, DMR-2039380

External User Project - 2021

# Stromataxy – Enabling the (otherwise) Unreachable

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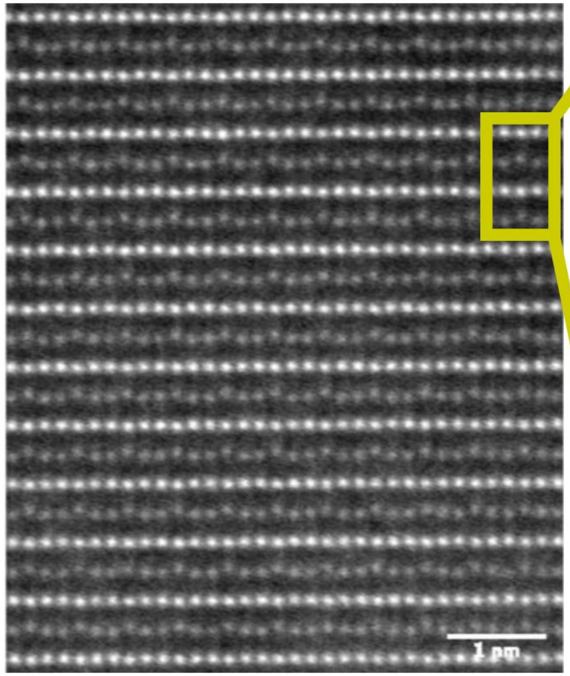
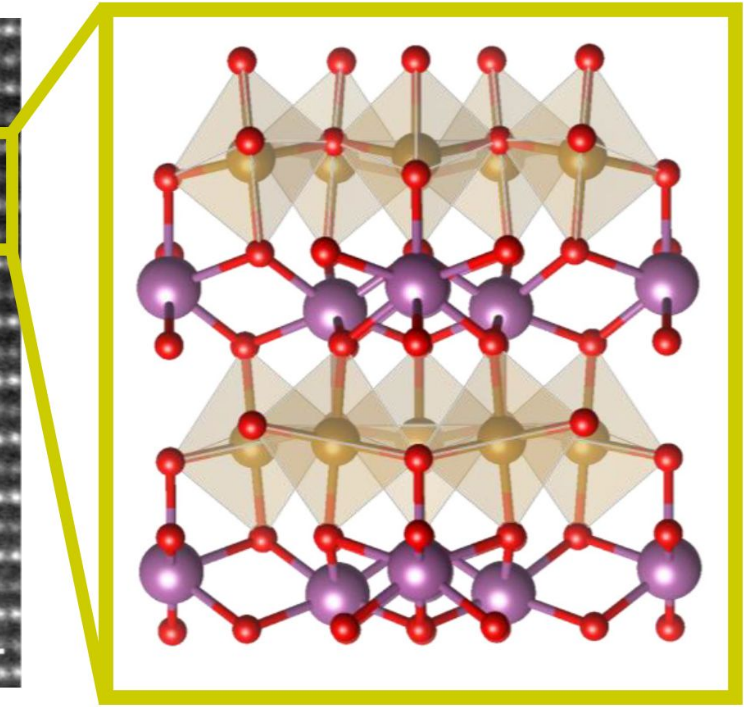
The properties of any material are largely governed by its constituting elements and the arrangement of those atoms. Different structures can result in vastly different behavior, even for the same chemical composition. Thus, to achieve a desired structure—the one with the desired properties—it is vital to be able to navigate synthesis pathways.

Here, users from the Naval Research Lab wanted to grow $ScFeO_3$, where five different ways are known in which the same atoms can be arranged. In the past, different substrates have been used to select between the various polymorphs by altering the energetics of materials growth through a process known as epitaxial stabilization.

Now, using PARADIM's signature MBE system, the users show that the timing of the arrival of the constituting species on the substrate surface also matters and that this control knob can overpower epitaxial stabilization for the growth of layered phases, like the hexagonal polymorph of $ScFeO_3$. They managed to stabilize this metastable phase of $ScFeO_3$ on substrates that had previously been shown to favor other polymorphs of the material, establishing stromataxy as a viable option, where common approaches are not available.




Scanning transmission electron microscopy of a layered $P6_3cm$ $ScFeO_3$ film (scale bar = 1 nm).



Schematic of the theory-derived unit cell for the layered hexagonal $P6_3cm$ structure [purple, Sc; tan, Fe; and red, O].

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