

Mapping electronic phase coexistence in nickelate superlattices by STEM-EELS

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To study the electronic couplings that are established at the coherent interfaces of epitaxial heterostructures, and their characteristic length-scales, novel characterization techniques capable of mapping electronic phase coexistence at the atomic-scale level are required. Here, we show that scanning transmission electron microscopy in combination with electron energy-loss spectroscopy (STEM-EELS) can be used to map electronic phase coexistence in rare-earth nickelate materials, a system whose physical properties are determined by a strong interplay between its structural, magnetic and electronic properties [1]. The feasibility of the experiment is demonstrated by using two (NdNiO₃/SmNiO₃) superlattices (SLs) whose constituent SmNiO₃ layers are either insulating or metallic at room temperature depending on their corresponding layer thickness [2]. By tracing the changes appearing in the O K and Ni L edge fine structures across both SL, we are able to map their metallic and insulating regions, and to further estimate the width associated to the metallic/insulating boundaries [3].

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