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TITLE:
Physical properties and crystallization temperature of rare earth scandate films

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ABSTRACT BODY:
The crystallization temperature of materials is a critical parameter to be considered when selecting high-k dielectrics for transistor gate applications. A low crystallization temperature is clearly required for crystalline films (to allow deposition onto partially formed device structures), whereas applications of amorphous layers rely on the opposite condition such as to avoid unintended crystallization during further processing. The great recent interest in rare earth scandates ($ReScO_3$, where Re = La, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y) has motivated us to investigate crystallization temperatures systematically, by employing a temperature-gradient deposition method. In this approach, pulsed laser deposition is used to grow $ReScO_3$ films simultaneously on 15 $LaAlO_3$ substrates held at different temperatures in the range of 200 - 800 °C. Subsequent analysis by X-ray diffraction allows us to determine the crystallization temperature for each of these materials. The obtained epitaxial films are then analyzed by 2-modulator generalized ellipsometry for their optical properties (in particular the refractive index in the range λ = 300 - 800 nm) and by scanning microwave microscopy for their dielectric permittivity (at f = 1.6 GHz). The resulting phase map of dielectric constant, lattice parameter, and crystallization temperature, provides valuable guidance in the selection of these materials for specific applications.
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