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Growth-temperature optimization and systematic study of composition dependencies in electro-optic (Sr_{1-x}Ba_xNb₂O₆) and high-k (ReScO₃) thin films

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A characteristic feature of many combinatorial materials science and continuous compositional spread (CCS) approaches is the opportunity to obtain a vast array of materials on a single small substrate. However, this requires the development of specialized measurement and characterization tools. A different CCS approach, based on pulsed-laser deposition, has been developed such as to yield the lateral variations of composition and temperature on length scales of several centimeters, thus enabling characterization of the resulting samples by traditional measurement techniques. In addition, this technique allows for alloying to occur during growth, thus enabling the formation of metastable phases.
In this presentation, results are shown for the technologically important electro-optic material Sr_{1-x}Ba_xNb₂O₆, where the growth temperature was optimized using a temperature-gradient technique, and the material's physical properties were then determined as a function of composition x. Similarly, the method was applied to a class of materials currently being investigated as potential high-k gate dielectrics, namely the rare-earth scandates ReScO₃ (with Re = La, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y). Here, the crystallization temperature was systematically investigated, and results regarding their optical and dielectric properties are presented.

Keywords: scandates, electro-optic films, high-k oxides, compositional-spread