Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Electron Beam Excitation Mechanism of Rare Earth Ions in $LiNbO_3$[1] S. TAFON PENN, V. DIEROLF, G.S. CARGILL III, Lehigh University
— Many applications of ferroelectric materials in frequency conversion are based on precise engineering of the ferroelectric domains. Unfortunately, the quest for smaller feature sizes is slowed due to the lack of real-time local controls of the process. We explored the possibility to use as local probes RE ions in $LiNbO_3$ that exhibit in their excitation and emission spectra linear Stark shifts making them sensitive to local electric fields such as local charging and fields from defect dipoles. We studied the feasibility of this approach for the domain writing process induced by an e-beam in a SEM. A necessary first step is a good understanding of the excitation mechanisms of RE:$LiNbO_3$ that leads to CL under e-beam irradiation. We observe a pronounced saturation already for moderate e-beam currents indicating that not all RE ions can be excited. This excludes the direct excitation pathway as a major contributor towards the RE excitation. Our observations are explained by a defect trap mediated energy transfer between generated electron-hole pairs and the RE ions. Independent of the RE ion, we find that the energy transfer rate from the defect trap to the RE ion is less than $(100\mu s)^{-1}$. Under saturation, this small rate and the limited number of defect trap-RE ion pairs restricts the achievable CL intensity and the applicability of the proposed real-time probing scheme.

[1]Supported by ARO-Grant W911NF-04-1-0323.

Samson Tafon Penn
Department of Physics, Lehigh University

Date submitted: 29 Nov 2007 Electronic form version 1.4