

# Directional FE Properties

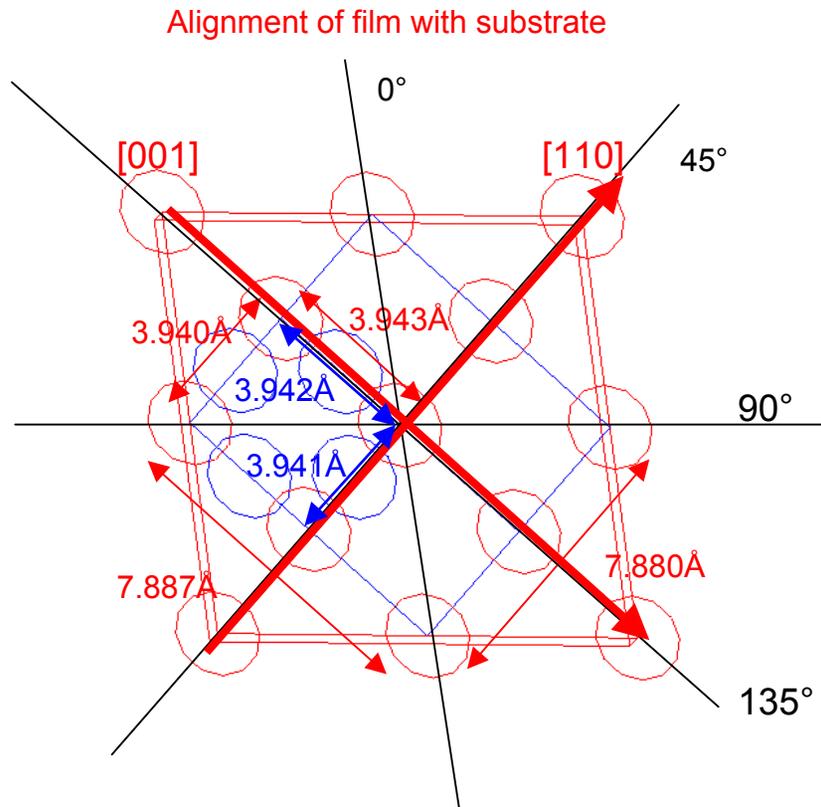
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ISIF 2004 Microwave Materials and Devices, Invited talk (2004)

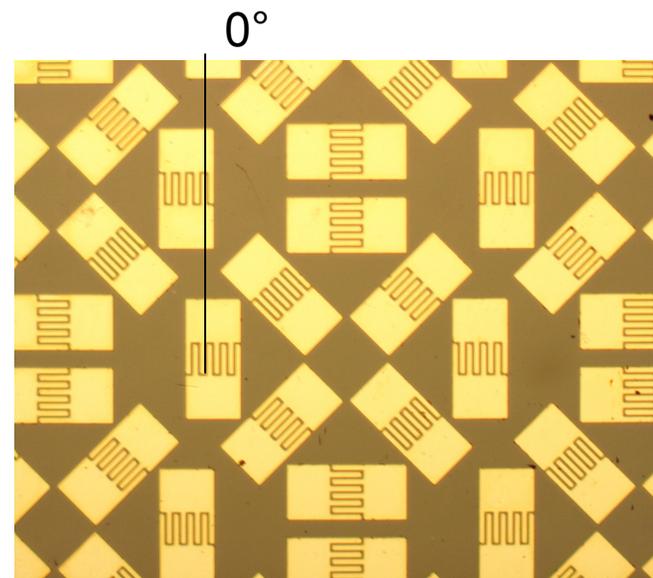
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- Thin films of the ferroelectric, FE,  $\text{SrTiO}_3$  were grown on (110)  $\text{DyScO}_3$  substrates
- Significant difference has been observed in terms of capacitance and % tuning in  $\text{STO}[010]\text{DSO}[001]$  and  $\text{STO}[100]\text{DSO}[110]$ .
- In-plane lattice parameters ( $a[100]$  and  $a[010]$ ) of the strained STO films is slightly different ( $a[100]=3.941\text{\AA}$  and  $a[010]=3.942\text{\AA}$ ).
- Study of the directionally-dependent phase transition and how the loss mechanism changes with DC bias around the phase transition has been investigated.
- Non-zero directional local electric field and directional film strain are being correlated with the observed behavior.

# Geometry used to quantify electrical anisotropy

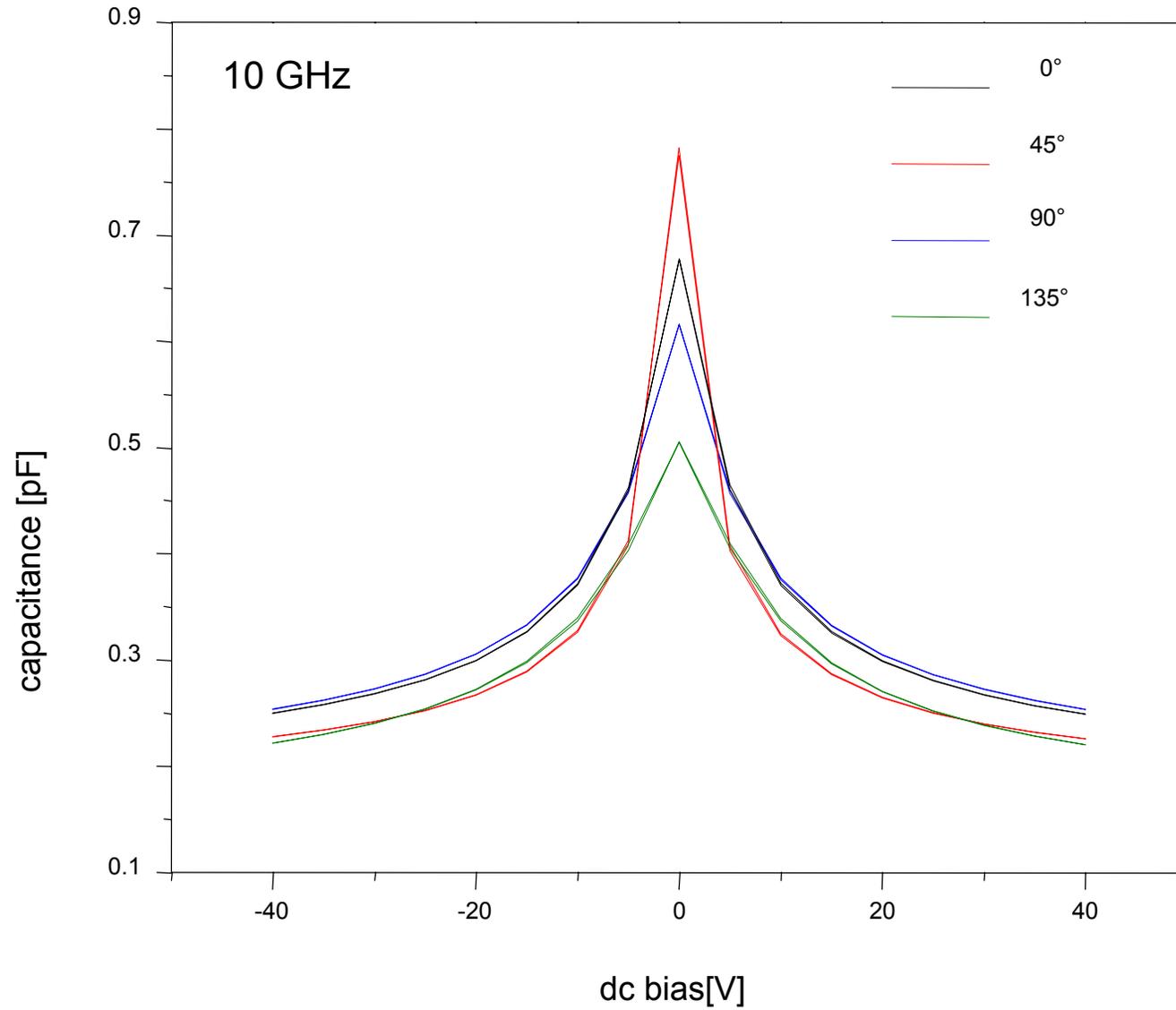


Photograph of device array



$\text{DyScO}_3$ ;  $\text{LnMO}_3$  structure ( $\text{Pbnm}$ ) with  $a=5.440\text{\AA}$ ,  $b=5.713\text{\AA}$ ,  $c=7.887\text{\AA}$  and  $\epsilon_a=22.0$ ,  $\epsilon_b=18.8$ ,  $\epsilon_c=35.5$

# Bias dependence of capacitance for different orientations



# Temperature dependence of capacitance and Q at 10 GHz for different orientations

