



# Project Brief

## Aging in High Temperature Piezoelectrics

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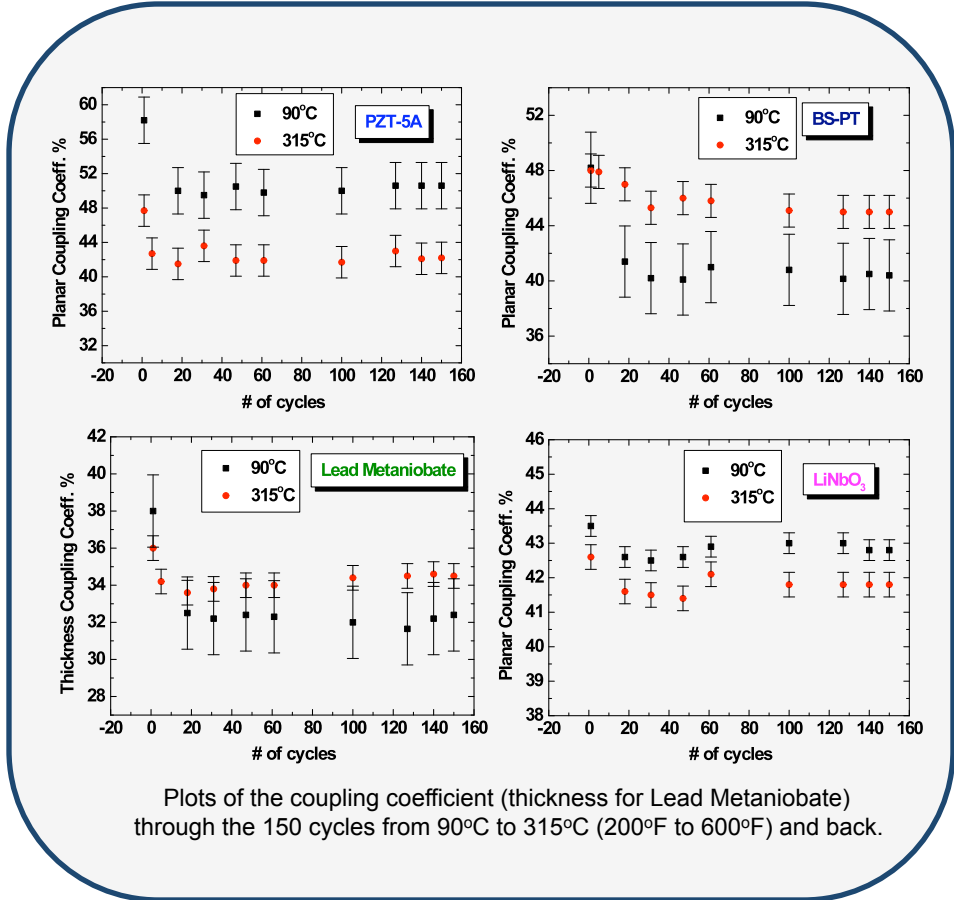
**Current Project:** To measure the effect of temperature cycling on the electromechanical properties of high temperature piezoelectrics.

**Experimental Procedure:**

Specimens of Bismuth Scandate-Lead Titanate (BS-64PT), Lead Metaniobate, Lead Zirconate Titanate (PZT-5A), and Lithium Niobate ( $\text{LiNbO}_3$ ) were run through temperature cycles from 90°C to 315°C (200°F to 600°F) and back. This was repeated 150 times.

**Results and Discussion:**

- (1) All samples except  $\text{LiNbO}_3$  showed some aging from the beginning to the end of the aging/cycling runs.
- (2) After the initial cycle from 90°C to 315°C, the coupling values for these samples did not change significantly throughout the run.
- (3) The cycling didn't seem to affect the sample aging any more than an isothermal run would have.



Comp.	Before cycling run				After cycling run				$\Delta d_{33}$ $\Delta k$	
	Cap	loss	$d_{33}$	coupling	Cap	loss	$d_{33}$	coupling		
PZT-5A	4.0nF	0.014	435	59%	4.34nF	0.017	385	52%	-12%	-12%
Lead Meta	635pF	0.009	90	37% ( $k_T$ )	515pF	0.02	78	32.2% ( $k_T$ )	-13%	-13%
BS-PT	3.4nF	0.007	330	44%	3.2nF	0.013	265	37%	-20%	-16%
$\text{LiNbO}_3$	94pF	0.000	40	43.5%	95pF	0.04	39	43%	-2%	0%

Comparisons at room temperature of the dielectric and piezoelectric properties of the tested samples before and after the run.  
PZT-5A maintained a high coupling coefficient, higher than BS-64PT even though BS-64PT has a higher  $T_C$  (>100°C) than PZT.