

Small Capacitor Measurements using Precision Tester

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Table of Contents

- Test configuration.
- Results for nominal $1\mu^2$. capacitor
- Result for nominal $0.33\mu^2$.
- Acknowledgements

Test Configuration

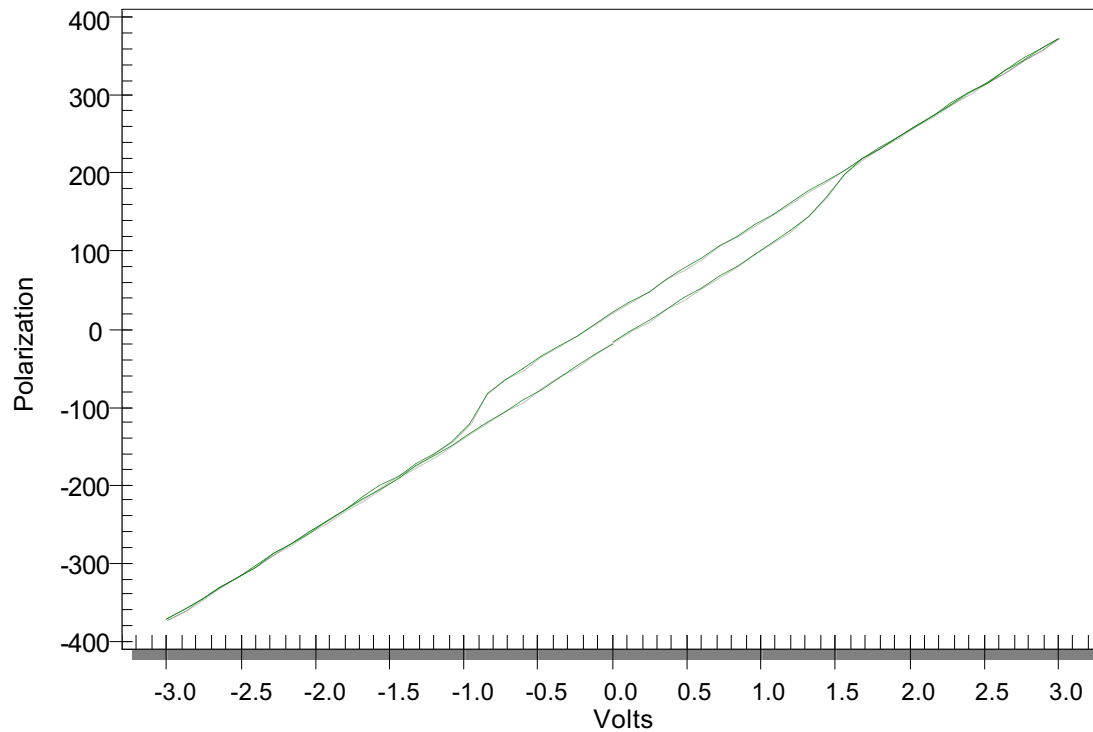
- The capacitors tested consisted of 20/80 PZT on LSCO electrodes. The PZT was nominally 2000Å thick.
- The data was taken primarily on a DI Dimension 3000 AFM head with a Nanoscope III controller. The Small Cap tester was placed on the table with the DI3000 and connected by short coax to the cantilever.
- The Small Capacitor tester was configured for $\pm 10V$ range and could execute hysteresis loops to 2KHz and pulse measurements down to 40 μs .

1 μ^2 Capacitor Results

- The capacitor area was no larger than 1 square micron but, due to erosion of the top electrode during Focused Ion Beam etching, could have been as small as 0.5 square microns.
- We used 1.0 square microns for calculating the polarization of the capacitor during the measurement.
- We measured Hysteresis, PUND vs Volts, IV, and Remanent Hysteresis for this capacitor.

1 μ^2 Hysteresis (As measured)

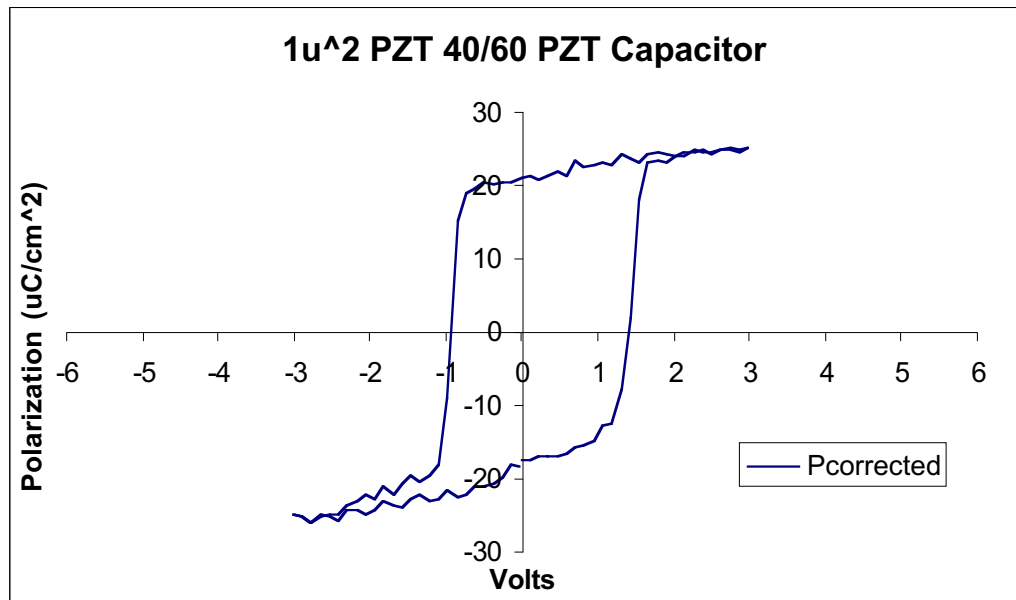
Average +Hyst for NVV46 1 μ^2 Capacitor
[2000A 40/60 PZT on LSCO]



- 1Khz at $\pm 3V$. Averaged 5 times.

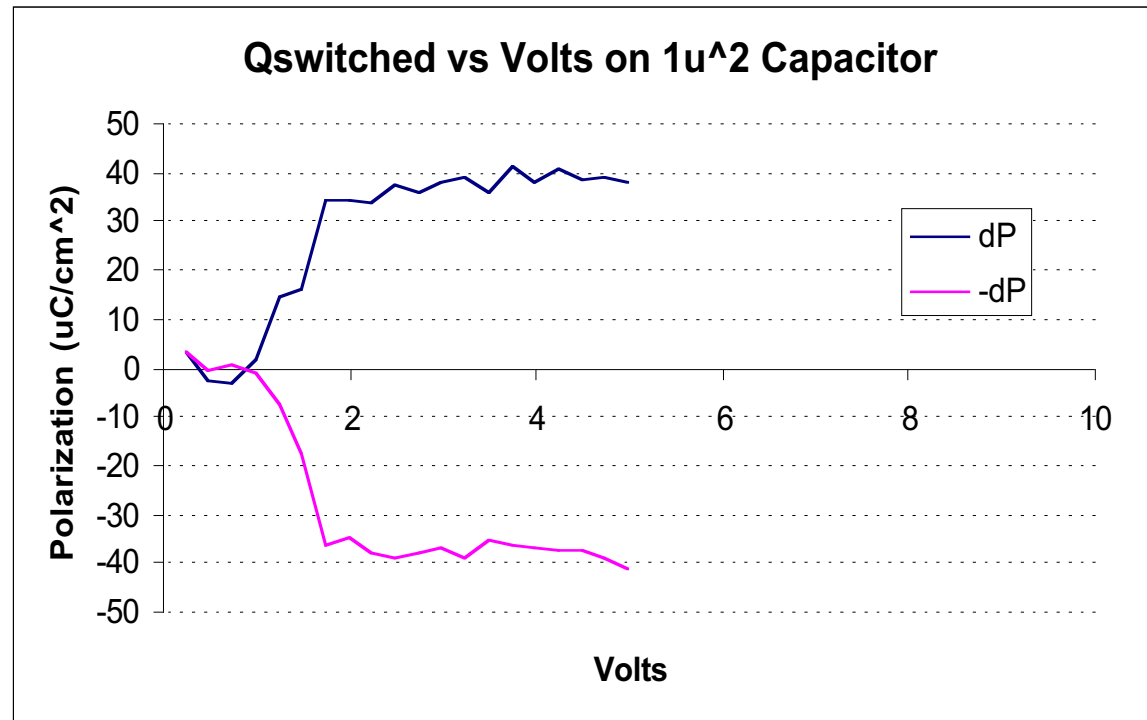
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1 μ^2 Hysteresis (Corrected for Parasitics)



- 1Khz at $\pm 3V$. Averaged 5 times.

1 μ^2 deltaP vs Volts

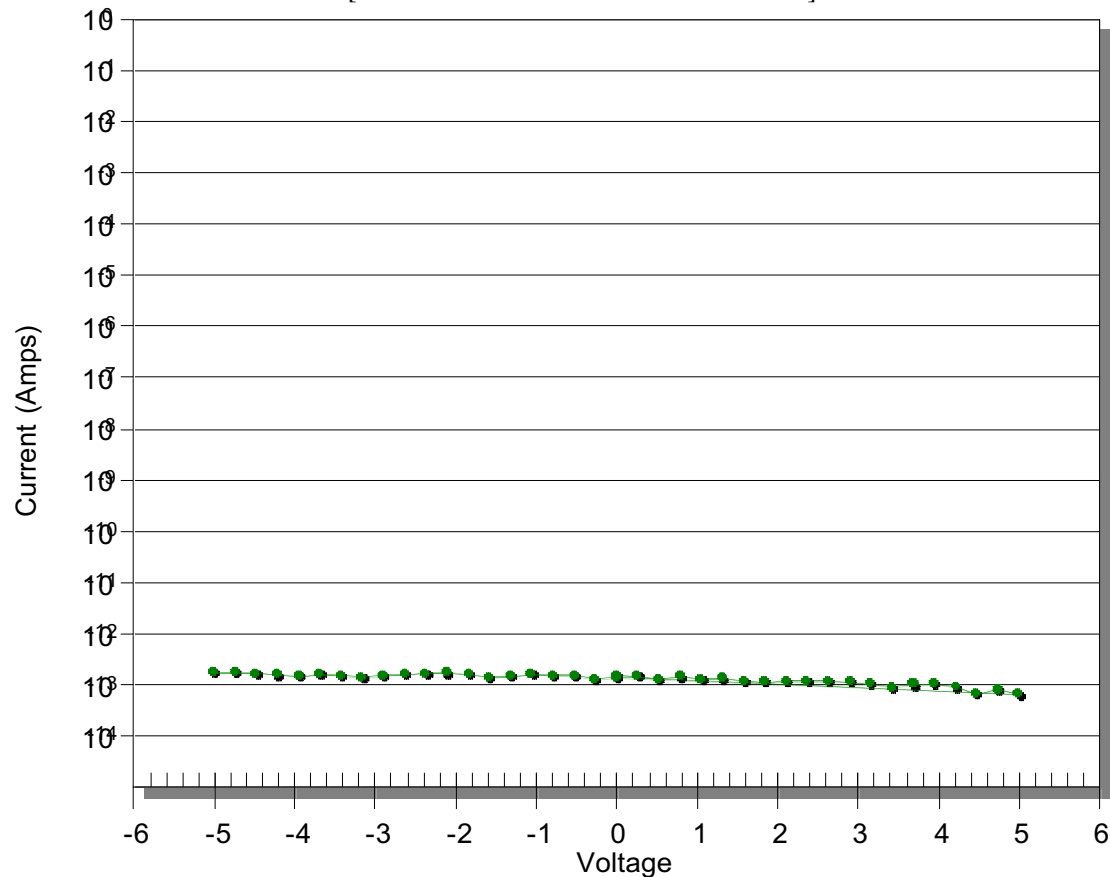


- 100 μs pulse widths. One second between pulses. Voltages from 0.25V to 5V in 0.25V steps. dP for the Radiant PUND test is equivalent to Qswitched.

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1 μ^2 Leakage

Unswitched I/V of NVV46 1 μ^2 Capacitor
[2000A 40/60 PZT on LSCO Electrode]

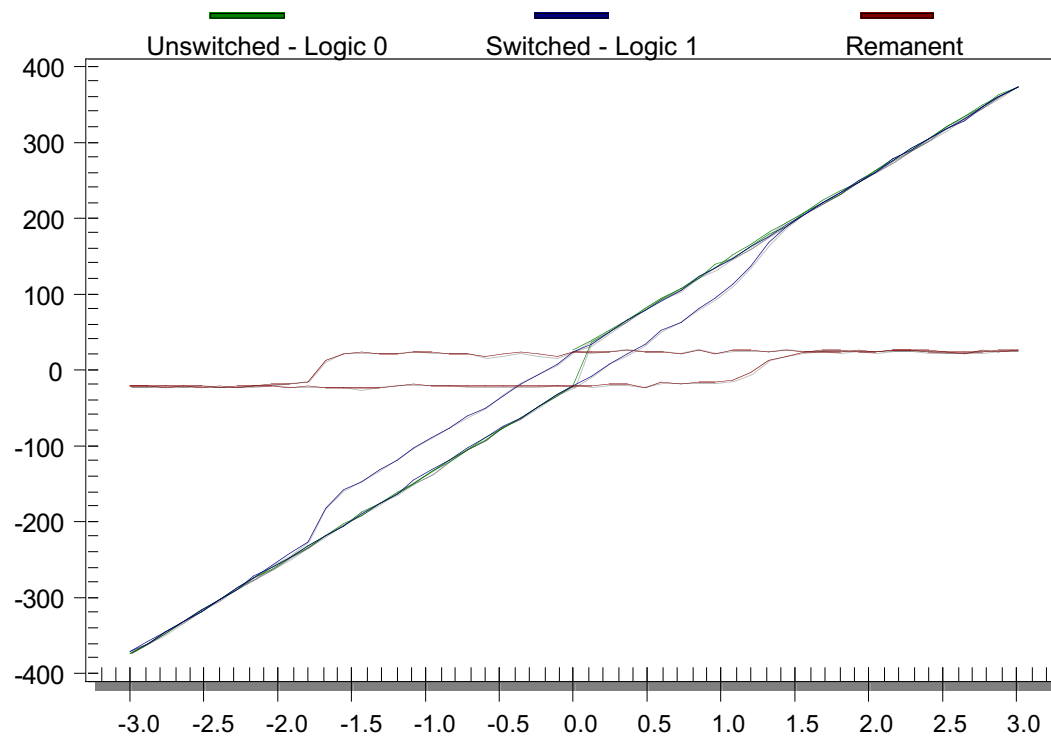


- 10 second integration time. Switching and non-switching results are identical.

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1 μ^2 Remanent Hysteresis (As Measured)

Remanent Hysteresis Measurement of NVV46 1 μ^2 Sample
[2000A 40/60 PZT on LSCO]

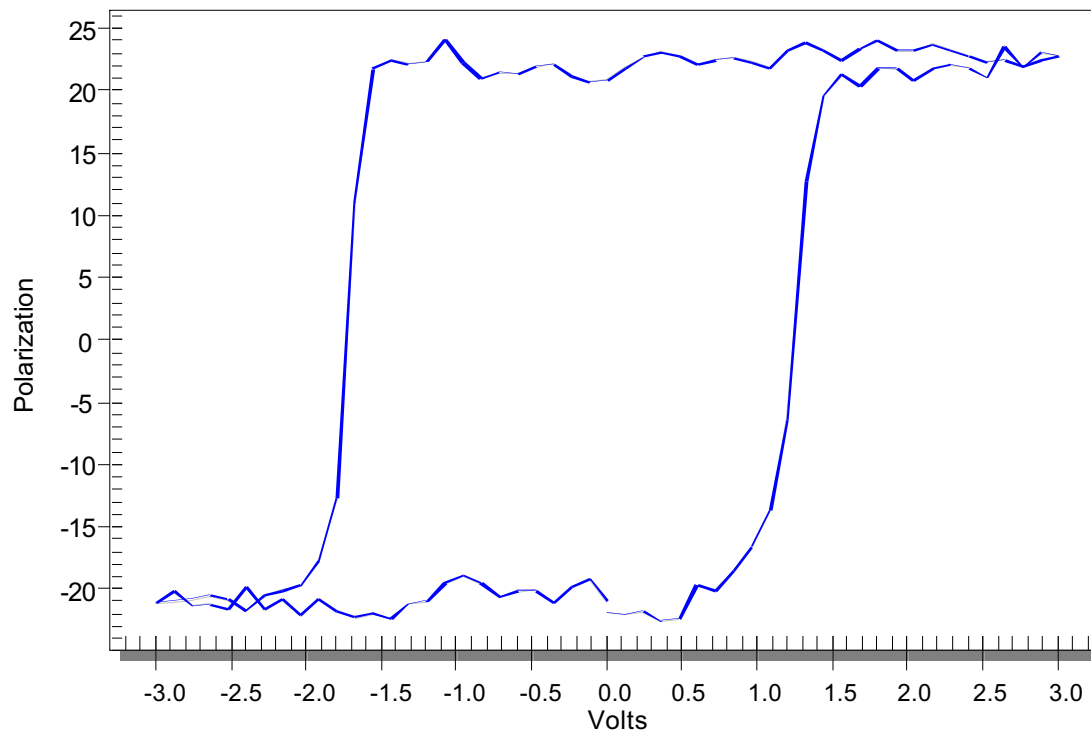


- 1Khz at $\pm 3V$. Single measurement with no averaging.

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1 μ^2 Remanent Hysteresis (Averaged 5 times)

Average Remanent Hysteresis of NVV46 1 μ^2 Capacitor
[2000A 40/60 PZT on LSCO Electrode]



1Khz at $\pm 3V$. Averaged 5 times.

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Data herein is proprietary to Radiant Technologies,

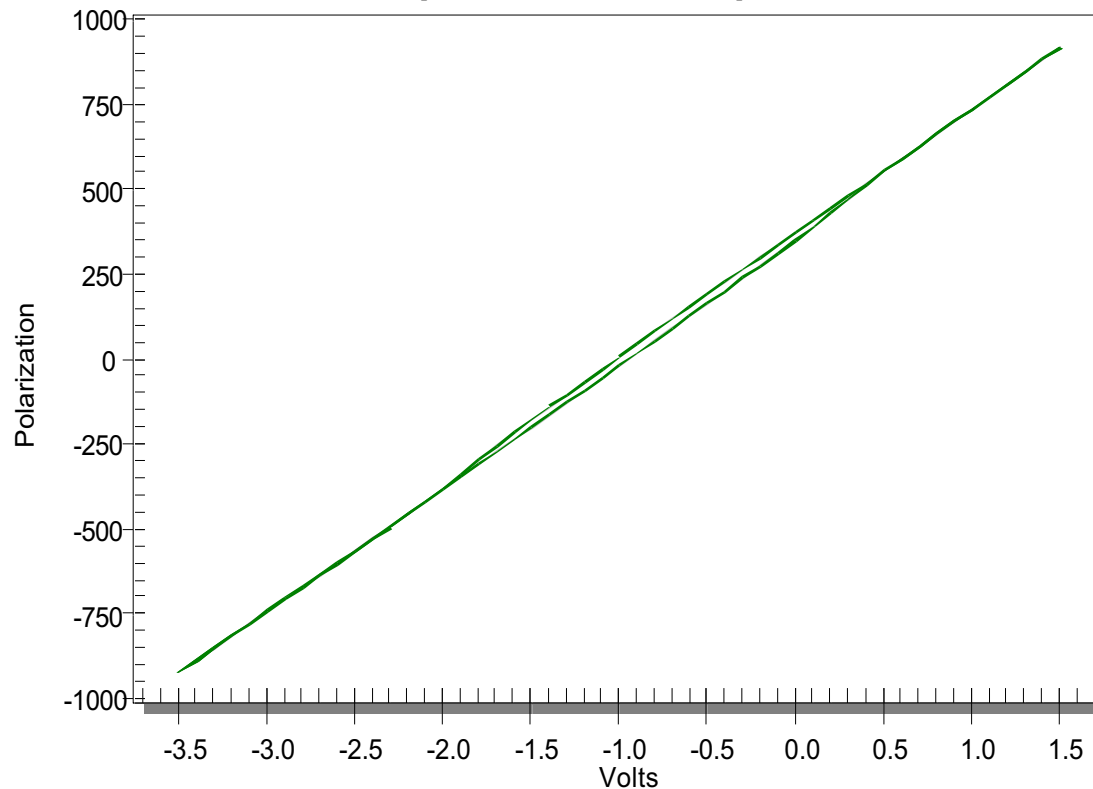


0.33 μ^2 Capacitor Results

- The capacitor area was no larger than 0.33 square microns but may have been smaller due to erosion of the top electrode during Focused Ion Beam etching. We conducted a study of the topology of the top electrode using the AFM and estimated the actual top electrode area to be approximately 0.1 square microns.
- We used 0.33 square microns for calculating the polarization of the capacitor during the measurement.
- The capacitor was measured from hysteresis.

0.33 μ^2 Hysteresis (As measured)

Average -Hyst for NVV46 0.33 μ^2 Capacitor
[2000A 40/60 PZT on LSCO]

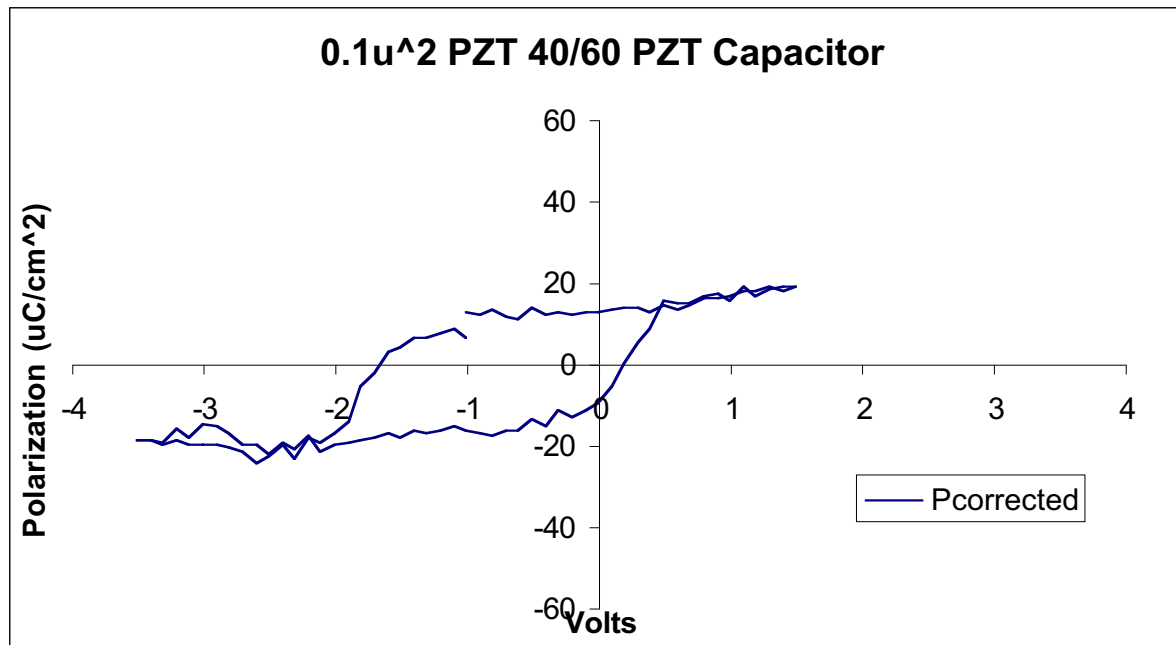


- Averaged 20 times.

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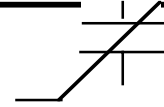
0.33 μ^2 Hysteresis

(After eliminated parasitics)



- Averaged 20 times. The capacitor appears to have a built-in offset, probably a by-product of the FIB etching procedure.

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Acknowledgements

Radiant would like to thank Dr. Ramesh of the University of Maryland for allowing the use of his equipment and capacitors as well as Dr. Ramesh's graduate students for their enthusiastic assistance.