In the last few years piezoresponse force microscopy (PFM) has become the leading technique to obtain ferroelectric information at the nanoscale. PFM hysteresis loops and switching images have been taken as a ferroelectric signature in several works, however similar PFM measurements in non-ferroelectric systems such as glass or silicon have been also obtained [1-3], for this reason Q. N. Chen et al [4] proposed several strategies to differentiate the electromechanical mechanism and one of them is to use the first and second harmonic of the tip-sample contact resonance frequency where piezoelectricity is related to the first harmonic and electrostriction to the second; the first must be higher than the second in ferroelectric samples. But the value of these harmonics depend on the voltage and the applied frequency. In this work, studies of first and second harmonic have been carried out on PZT thin films using conductive cantilevers with different dimensions, thus with different resonance frequency, therefore allowing to investigate the harmonics dependence with the resonance frequency. By using larger cantilevers in the first contact resonance frequency, ~65kHz, the piezoelectric and the electrostrictive signals show a small difference, however, for the second contact resonance, ~210kHz, the first harmonic is clearly higher than the second. For a short cantilever, with a resonance frequency at ~315kHz, a very much higher value of the first harmonic is obtained in comparison to the second. These results suggest the use of second resonance frequency for larger cantilevers, but short cantilevers are better for avoiding non-ferroelectric signals in PFM experiments, therefore extending the criterion given by ref. [4] to differentiate ferroelectric from non-ferroelectric samples.

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**References:**


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