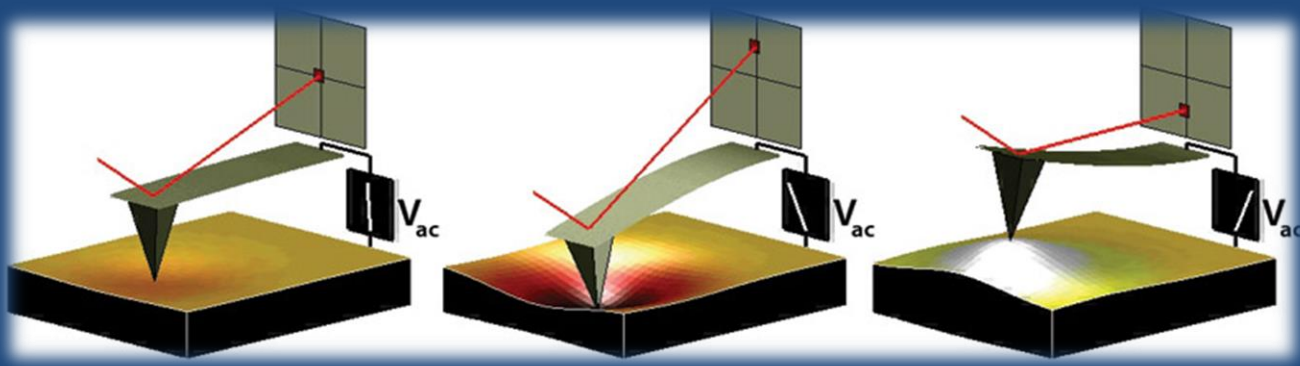
PIEZO RESPONSE FORCE MICROSCOPY

Piezoresponsive materials are substances that undergo mechanical deformation in response to an applied voltage. The properties of piezoresponsive materials make them useful in a wide range of areas, from Microelectromechanical Systems (MEMS) to biosensors. Following the miniaturization challenge, novel techniques are required for the evaluation of ferroelectric and piezoelectric properties with the high, ultimately nanoscale resolution. ARA's Piezo Response Microscopy (PRM), now enables high-resolution nano and subnano scale characterization of variety of piezoelectric materials and topographical imaging using contact mode scanning.



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Theory:

an electrical voltage (V_{ac}) is applied to the sample surface with a conductive tip of an AFM. In response the sample then locally expands or contracts (Z).

$$V_{tip} = V_{dc} + V_{ac}\cos(\omega t)$$

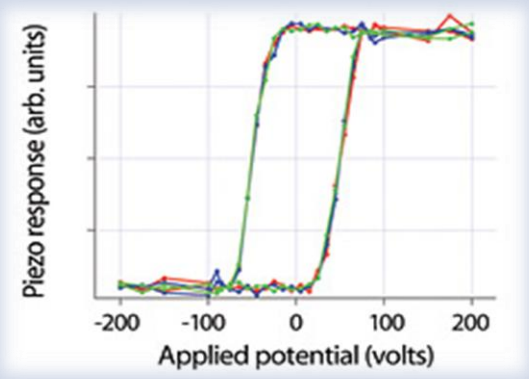
$$Z = Z_0 + A(\omega, V_{ac}, V_{dc})\cos(\omega t + \varphi)$$

$$Z = d_{33}V_{dc} + d_{33}V_{ac}\cos(\omega t + \varphi)$$

Where d_{33} is the most important component of piezoelectric tensor which material is described by.

Advantages:

- Simultaneous acquisition of topography and piezoresponse
- High resolution on the nanometer scale.
- Allows manipulation of ferroelectric domains.
- Non-destructive.
- Little sample preparation required.



Applications:

- Domain imaging and investigating domain formation on nanometer length scales with nanosecond time resolution
- Studying piezoelectric materials behavior with high resolution.
- Characterizing electromechanical responses and acquiring Hysteresis loop of piezoelectric materials.