Piezotech Processing Guide

- Piezotech FC - Calculations -

Deformation under electrical field

The deformation caused by the applied electric field can be defined by the simple formula:

$S_i = d_{3i}E$ i=1;2;3

Where

- $S_i = \Delta x_i / x_i = \Delta L / L$ and represents the strain (relative deformation) of the sample in the x_i direction
- d_{31} is the piezoelectric strain constant

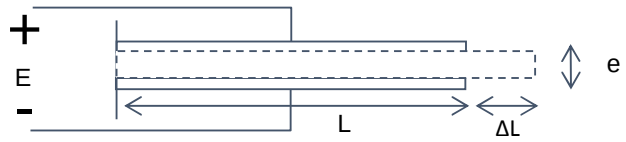
Example of an element with the following characteristics:

Length: l=1cm
Width: w=2mm
Thickness: t=9µm
Applied voltage: V=200V -> E (electric field) = V/t
The piezo strain constant d is given by:

$$d = \frac{strain\ developed}{applied\ field} = \frac{S}{E}$$

(d_{31}, d_{32}, d_{33}) = (11, 10, -30) pC/N

$$\Delta L = d_{3i} * \frac{V}{t} * L = 2{,}44\ \mu m$$



Sensors: Orders of Magnitude, Voltage generation

The electrical field output (E) caused by an applied force can be defined by:

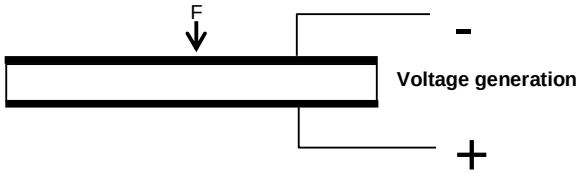
$E = g_{ij}\sigma_i$

Where:

- σ_i is the applied mechanical stress (N/m²)
- g_{ij} is the piezoelectric voltage constant (Vm/N)

$$g = \frac{electrical\ field\ developed}{applied\ mechanical\ stress} = \frac{E}{\sigma}$$

(g_{31}, g_{32}, g_{33}) = (216, 19, -339) $*10^{-3}$ - Vm/N



Example of an element with the following characteristics:

Length: l=2cm
Width: w=2cm
Thickness: t=100µm
Compression 0.1 Bar (104 Pa) 4N -> σ=10000N/m²

$$E = \frac{V_0}{t} = g_{33}\sigma_3$$

$$V_0 = g_{33}\sigma_3 t = 339mV$$

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