Piezoelectricity

Piezoelectricity is the electric charge that accumulates in certain solid materials in response to applied mechanical stress [1]. The word piezoelectricity means electricity resulting from pressure and latent heat. It is derived from Ancient Greek πιέζω (piézō) 'to squeeze or press', and ἤλεκτρον (ḗlektron) ' amber ' (an ancient source of electric current) [1].

Piezoelectric materials are ionically bonded and contain positive and negative ions in the form of pairs called unit cells. These materials are available in nature as an anisotropic dielectric with non-Centrosymmetric crystal lattice i.e. they don't have any free electrical charges and the ions lack a centre of symmetry [1]. When mechanical stress or friction is applied on these materials, the geometry of the atomic structure of the crystal changes due to net movement of positive and negative ions with respect to each other, resulting in electric dipole or Polarization. Thus the crystal changes from a dielectric to a charged material. The amount of voltage generated is directly proportional to the amount of stress or tension applied to the crystal [1].

Piezoelectric tiles are a type of tile that uses piezoelectric crystals to convert foot pressure into electricity. The crystals produce small charges that combine to form a large source of power. The power can be stored in a battery and used for various applications, such as Radio-frequency identification (RFID) [1].

Working of Piezoelectric TILE

Piezoelectric tiles harness the piezoelectric effect, which is the ability of certain materials to generate an electric charge in response to mechanical stress. Here's how they typically work:

1. **Material Selection:** Piezoelectric materials, such as certain crystals or ceramics, are chosen for their ability to convert mechanical energy into electrical energy and vice versa.
2. **Tile Design:** The piezoelectric material is often integrated into a tile-like structure. These tiles can be designed in various shapes and sizes to suit different applications.
3. **Mechanical Stress Application:** When mechanical stress or pressure is applied to the piezoelectric tile, it causes the material to deform slightly. This deformation results in the displacement of electric charges within the material.
4. **Electric Charge Generation:** The displacement of charges creates an electric potential across the material, generating an electric charge. This electric charge can be harnessed as electrical energy.
5. **Energy Harvesting:** In practical applications, piezoelectric tiles are often used to harvest energy from various sources, such as footsteps, vibrations, or other mechanical movements. For example, in smart infrastructure, these tiles could be integrated into walkways to convert the mechanical energy from people walking into electrical energy.
6. **Utilization:** The generated electrical energy can be stored in batteries or capacitors for later use, or it can be directly utilized to power low-energy devices or sensors.

Explanation of Project's working in Depth

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Electricity generation through the use of ceramic piezoelectric tiles have three stages:

The piezoelectric ceramic tile is the system for generating electric energy which converts vibratory energy into electric energy.

The rectifier device as a part of electrical power conversion into DC voltage.

The piezoelectric tiles can be installed in high-traffic areas like subway stations and sidewalks . They can be used to harvest energy from people walking vibration for generating and accumulating energy.