(Reference)

Kinds of Pyroelectric Materials

Table 1 shows properties of pyroelectric materials taking into consideration the fundamental properties. The table contains values which can be calculated from substance constant of material as performance index, but other values should also be considered depending on using wave length zone and frequency zone as mentioned before. The values in the table has, give only rough standard. Each pyroelectric material is briefly mentioned below.

1. TGS (Triglycin Sulphate)

TGS crystal has excellent performance indices such as pyroelectric coefficient, dielectric constant, dielectric loss and specific heat. The good qulity crystal can easily be manufactured and the IR beam absorption begins from 2um. Surely it is a good pyroelectric material. However, the reason why it is not widely used for industrial products is a high cost of grinding because of wate soluble crystal, a big sensitivity dependence due to low Tc (490°C) and a low using temperature (hard to use above 40°C and impossible to use above 49°C).

2. $LiTaO_3$/$LiNbO_3$ Single Crystal

There no weakness pointed out for TGS and $LiTaO_3$ is one of best materials second to TGS in terms of performance index. The dielectric constant for $LiTaO_3$ is small ranging from ε=40 to 50, which is preferable. In case that the area of element is small, the capacity of element becomes smaller than the capacitance of outside circuit (FET gate capacity and staray capacitance), which causes reduction in sensitivity and slow response.

$LiTaO_3$ crystal is currently used for pyroelectric IR sensor element for commercial applications such as crime prevention system and cooker because of relatively large property values, a wide range of using temperature (-20 - 100°C), easy procurement small variation of properties and possible production in a large scale. Pyroelectirc plate with about 50 μm thickness is commercially available.

3. $PbTiO_3$, PZT Ceramics

$PbTiO_3$ is a strong dielectric material having excellent properties as pyroelectric and piezoelectric material such as hihg curie temperature, high spontaneous polarization and small dielectirc constant. Therefore, at first, it was expected to be a piezoelectric material at high temperature and frequency. As pure $PbTiO_3$ ceramic is difficult in sintering, the high density, high resistance ceramic is obtained by adding sintering aid or forming solid solution.

Pyroelectric properties for PLZT ($PbTiO_3$-$PbZrO_3$-La_2O_3) have been studied for various compositions. Compositions of La4/Ti65/Zr35 and 7/65/35 have maximum pyroelectric coefficient but high dielectric constant (ε=680, 1860) which lowers the performance.