Answer on Question 59742, Physics, Electromagnetism

Question:

Given that the relative permittivity of porcelain $\varepsilon_r = 6.0$, calculate its electrical susceptibility in the presence of an electric field.

Solution:

Electrical susceptibility is defined as the constant of proportionality relating an electric field $\boldsymbol{E}$ to the induced dielectric polarization density $\boldsymbol{P}$ as follows:

$$\boldsymbol{P} = \varepsilon_0 \chi_e \boldsymbol{E},$$

here, $\boldsymbol{P}$ is the polarization density, ε_0 is the electric permittivity of free space, χ_e is the electrical susceptibility of the material and $\boldsymbol{E}$ is the electric field.

From this formula we can find the electrical susceptibility of the material:

$$\chi_e = \frac{P}{\varepsilon_0 E} = \frac{\varepsilon}{\varepsilon_0} - 1 = \varepsilon_r - 1,$$

here, $\varepsilon_r = \varepsilon / \varepsilon_0$ is the relative permittivity, or dielectric constant of the material, ε is the permittivity of the material.

Thus, from the last formula we can calculate the electrical susceptibility of porcelain in the presence of an electric field:

$$\chi_e = \varepsilon_r - 1 = 6.0 - 1.0 = 5.0.$$

Answer:

$\chi_e = 5.0.$