

5.21: Dielectric Breakdown

The permittivity of an ideal dielectric is independent of the magnitude of an applied electric field; the material is said to be “linear.”¹ However, all practical dielectrics fail in this respect with sufficiently strong electric field. Typically, the failure is abrupt and is observed as a sudden, dramatic increase in conductivity, signaling that electrons are being successfully dislodged from their host molecules. The threshold value of the electric field intensity at which this occurs is known as the *dielectric strength*, and the sudden change in behavior observed in the presence of an electric field greater than this threshold value is known as *dielectric breakdown*.

Dielectric strength varies from about 3 MV/m for air to about 200 MV/m in mica (a dielectric commonly used in capacitors).

Dielectric breakdown is typically accompanied by “arcing,” which is a sudden flow of current associated with the breakdown. A well known example of this phenomenon is lightning, which occurs when charge is exchanged between sky and ground when air (a dielectric) exhibits breakdown. Dielectric breakdown in solids typically damages the material.

1. See Section 2.8 for a review of this concept.↩

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