Title The electrical properties of hygroscopic solids

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Abstract

That hygroscopic solids have many properties in common has been well recognised in regard to the relationship between water vapour pressure and moisture content (the sorption isotherm) but less so in regard to their electrical properties. We show that the characteristic "logarithmic" dependence of the low frequency conductivity on moisture content arises from ionic hopping between the absorbed water molecules, a process that is largely independent of the nature of the absorbing substrate. Hopping charge transport produces a very similar concentration dependence in the permittivity and "giant" permittivity values at very low frequencies. The specific admittance (admittivity) is also proportional to the ionic concentration, which is dependent on sample history and measurement method. This makes comparison of results from different laboratories and the definition of material properties very difficult. At intermediate frequencies polarisation processes associated with microscopic substructures are observed. These vary considerably between different materials and consequently give rise to variation in the dielectric properties. At frequencies on the order of 1 GHz the admittivity is dominated by the dielectric response of the water molecule dipole. Permittivity values in this region are less than those for bulk water and the dependence on moisture content is linear.