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Dielectric absorption tests at room temperature within the frequency range 10^{-1} Hz - 10^{7} Hz for ADR Technology screening wall paint

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1. Research aim: to calculate the dielectric absorption window for ADR Technology screening wall paint in the frequency range of 10-1 Hz - 107 Hz at room temperature. The paint samples together with the electrodes were provided by ADR Technology Stanisław Wosiński.

2. Measuring methodology: Dielectric material is characterized by relative complex dielectric permittivity:

$$\varepsilon^* = \varepsilon' - j\varepsilon'', \quad (1)$$

where 'relative' refers to the normalization by the permittivity of free space ε_0 = 8.85×10^{-12} F/m. Dielectric losses:

$$\varepsilon'' = \varepsilon''_p + \frac{\sigma_{dc}}{\varepsilon_0 f} \quad (2)$$

are sum of dielectric polarization losses ε''_p and losses due to the Ohmic conduction $\frac{\sigma_{dc}}{\varepsilon_0 f}$ (σ_{dc} denotes the dc conductivity and f is the frequency of measuring field). The dielectric permittivity ε^* as well as the dielectric loss tangent:

$$\tan\delta = \frac{\varepsilon''}{\varepsilon'} = \frac{\left(\varepsilon''_p + \frac{\sigma_{dc}}{\varepsilon_0 f}\right)}{\varepsilon'} \quad (3)$$

are both dependent on the measuring frequency. In the frequency range from 1×10^{-1} Hz to 1×10^{7} Hz the dielectric properties should be measured for samples filling a measuring condenser (usually a parallel plate measuring condenser).

3. Apparatus and Experiment: Dielectric response of the samples was studied using an Alpha-A High Performance Frequency Analyzer (Novocontrol GmbH). Samples, with the composites filling a parallel plate condenser, ~2 mm thick with metal electrodes in form of discs with diameter of 15.5 mm, were fixed to a sample holder. The measurements were performed at room temperature (293 K). The impedance Z' (from 10^{-3} Ω do 10^{15} Ω), capacitance C (10^{-15} F do 1 F) and the tangent of the dielectric loss angle $tan\delta$ were measured in the interval of 8 decades of frequency (1 × 10^{-1} Hz to 1 × 10^{7} Hz) at the oscillation voltage of 1 V. The actual part of the dielectricity of the sample was calculated from the dependence:

$$\varepsilon' = \frac{d}{\varepsilon_0 S} C, \quad (4)$$

where d - is the thickness of the sample (in m), S is the surface of the sample (in m2), C - is its capacity (in F) and ε_0 = 8.85×10^{-12} F/m) is the dielectric constant of the vacuum. The imaginary part $\varepsilon''$of the composite dielectricity of the sample is:

$$\varepsilon'' = \varepsilon' \tan \delta.$$

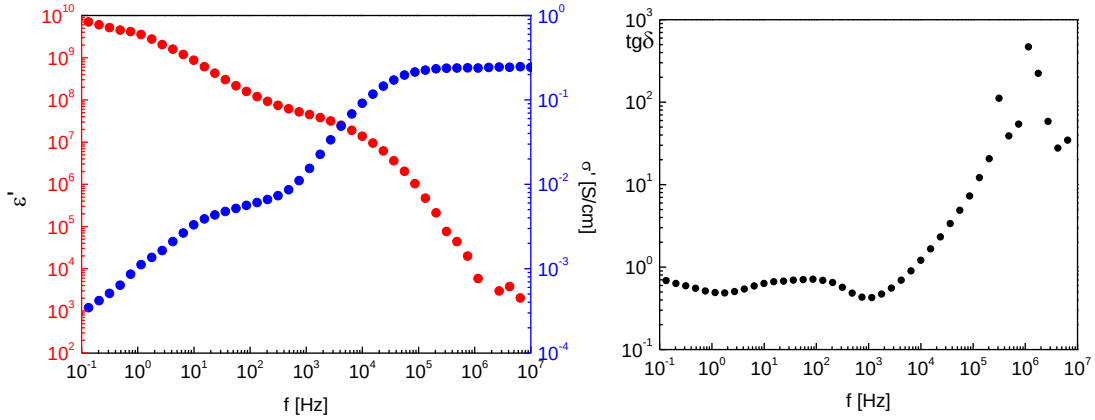
(5)

The measured values were stored and the values characterizing the sample were calculated using WinDETA impedance analysis software and WinFit V 3.2.

4. Results: Two series of dielectric measurements, 4 measurements for each were taken of the ADR Technology shielding paint.

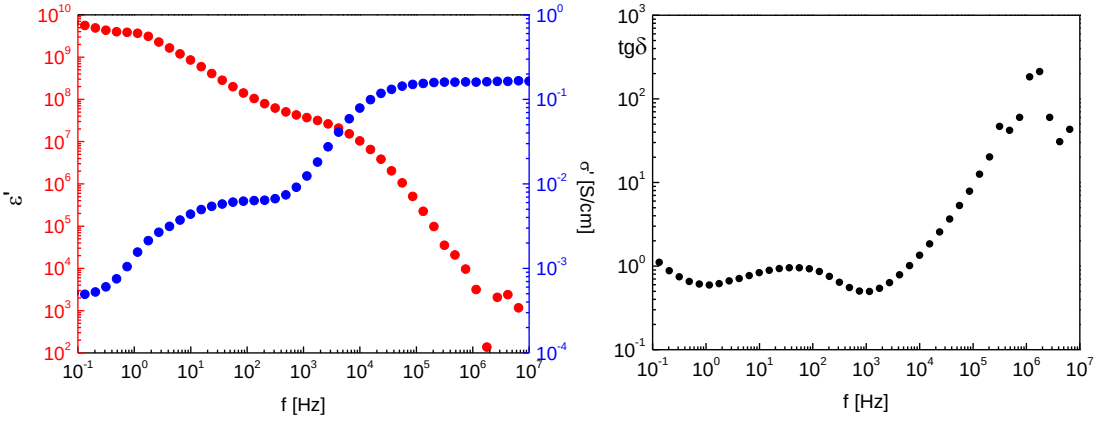
Series I

Measurements were made in an open space with a relative humidity of ~ 31% at room temperature (293 K) for the sample provided by ADR Technology. The results presented are the average of 3 measurements.



Series II

Measurements were made in an open space with a relative humidity of ~ 31% at room temperature (293 K) for the sample provided by ADR Technology. The results presented are the average of 3 measurements.



5. Summary:

i) ADR Technology shielding wall paint shows high ε' 'values in the entire frequency range from 0.1 Hz to 10 MHz with a plateau in the range of 100 Hz - 10 kHz.

ii) ADR Technology shielding wall paint has two dielectric absorption bands with $\tan\delta_E \approx 1$ at 100 Hz and with $\tan\delta_E \approx 100$ at ~5 MHz.