Dielectric characterisation of low content PVDF/CNTs and PVDF/Graphene nanocomposites

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Polyvinylidene fluoride (PVDF) is a polymeric material with a variety of technological applications mostly due to its piezoelectric character [1]. On the other hand allotropic forms of carbon such as carbon nanotubes (CNTs) or graphene layers are newly fabricated materials and attract scientific attention due to their outstanding electrical and mechanical properties.

The purpose of this work is to investigate the molecular dynamics of PVDF polymer chains and the way these dynamics are influenced by the presence of the filler. A powerful technique to study the molecular dynamics for composite systems is Broadband Dielectric Spectroscopy (BDS). PVDF/CNTs and PVDF/Graphene nanocomposites were prepared in three different concentrations 0.1%, 0.5% and 1%. Pure PVDF samples were also prepared and investigated as reference. Isothermal scans over a wide frequency range from 10^{-1} Hz to 10^{6} Hz were conducted from -100^{o}C to 150^{o}C in steps of 10^{o}C.

3D indicative graphs (figure 1a and 1b) of the imaginary part of dielectric modulus (M'') as a function of frequency and temperature for the composites with 1% PVDF / CNTs and PVDF / Graphene are presented respectively. The first recorded relaxation is the α_{α}-mode observed at low temperatures, also referred to as the primary relaxation, attributed to the glass to rubber transition of the polymer matrix. Around 0^{o}C the α_{c}-mode is observed and it is attributed to molecular motions of the polymer crystalline region arising from the imperfections of the crystal remaining present till the upper measured temperature. Finally, around 100^{o}C another mode is observed, namely Interfacial Polarisation (IP), arising from the morphological differences of the crystalline and amorphous phase [2, 3].

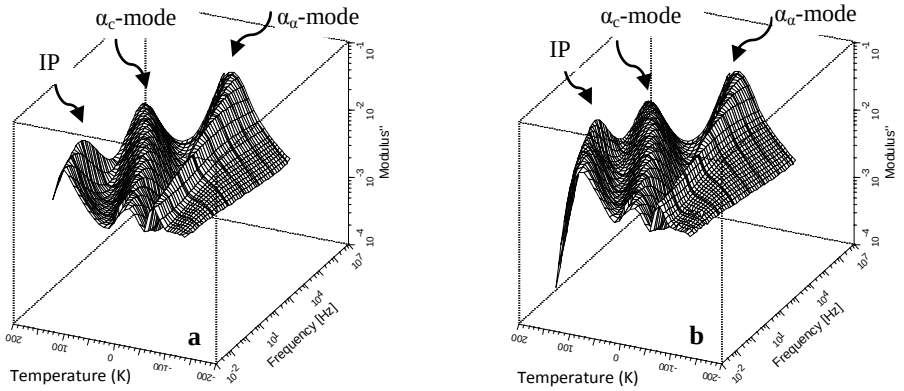

Figure 1: Imaginary part of dielectric Modulus (M'') as a function of frequency and temperature for the composites with 1% PVDF / CNTs (a) and PVDF / Graphene (b).

References

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[2] Huda Rekik et al, Composites: Part B **45**, (2013)
[3] V. Kochervinskii et al, Journal of Non-Crystalline Solids **353**, 47 (2007)

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