

STRUCTURE AND DYNAMICS OF ELASTOMERIC MATERIALS BY MEANS OF ^1H TIME-DOMAIN NMR: EFFECT OF CROSS-LINKING

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Elastomeric materials are nowadays of central importance in many fields of application, where they need to fulfil specific mechanical requirements. The mechanical properties of an elastomeric material take their origin on the features and topology of the polymer network. In fact fixed chemical cross-links and physical entanglements among polymer chains impose notable restrictions on chain mobility and are at the basis of rubber elasticity [1]. An additional reinforcement effect can be achieved by incorporation in the rubber matrix of different nanoparticles, such as carbon black, carbon nanotubes, nanosilica, and clays [2, 3]. So far extensive research efforts have been addressed to the comprehension of the relationships between the “molecular” and mechanical properties of elastomeric materials, but a full understanding is still lacking. In this frame, NMR spectroscopy can play an important role giving access to many structural and dynamics information on wide spatial and time scales. In this work we applied a combination of different time-domain NMR (TD-NMR) techniques to the study of elastomeric materials based on isoprene, butadiene and styrene-butadiene rubbers, with application in the tyre industry. In particular the influence of chemical cross-links on the polymer chain dynamics in a wide spectrum of motion frequencies was investigated, by studying samples obtained using different vulcanization conditions. ^1H Multiple Quantum (MQ) experiments [4] were used for the measurement of the residual ^1H - ^1H dipolar interaction: the latter is dependent on the anisotropic character of the fast reorientations of chain segments and, therefore, it is related to the amount and distribution of the topological constraints within the polymer network. Further and complementary information on different regimes of polymer dynamics were also obtained by means of measurements of ^1H spin-spin relaxation times (T_2) and variable temperature ^1H T_1 Fast Field Cycling (FFC) [5] experiments.

References:

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