

Orientational Order in Uniaxially Deformed Natural Rubber Crosslinked by γ -Irradiation

G. Žauhar¹, S. Valić^{1,2} and G. Baranović²

¹ University of Rijeka, School of Medicine, Braće Branchetta 20, Rijeka, HR-51000, Croatia, gordz@medri.hr

² Rudjer Bošković Institute, Bijenička 54, Zagreb, HR-10000, Croatia

A better understanding on molecular level of natural rubber cross-linked by γ -irradiation was obtained by combining a characterization of swelling behavior with an analysis of chain segmental orientation accompanying deformation. A spectroscopic technique named linear infrared dichroism has been applied for measurement of orientation of specific labels on a chain relative to a laboratory-fixed axis, the orientation being suitably induced by stretching the sample uniaxially.

Natural rubber (NR) latex containing 62% of dry matter was irradiated with different total irradiation doses from 100 kGy to 400 kGy. The liquid phase was then removed by evaporation at room temperature in order to obtain thin NR films. The samples were uniaxially deformed with various value of λ ($\lambda=l/l_0$, where l and l_0 are lengths of a sample in the deformed and relaxed state, respectively). Infrared measurements performed on a Bomem MB102 FTIR spectrometer are used to characterize orientational behavior of NR samples having different crosslink densities, depending of total irradiation dose. In addition to the infrared measurements, crosslink densities of the samples are estimated by swelling in toluene.

We have examined the dichroic behavior of the bands located at 837 and 2727 cm^{-1} . It is observed that these two bands display different dichroic behavior: the first exhibits negative while the second exhibits positive orientation. The largest increase in the orientation level evidenced by infrared dichroism is observed for the sample of natural rubber cross-linked by γ -irradiation with dose of 200 kGy. Shift of the absorption band located at 837 cm^{-1} to higher wave numbers on stress-induced crystallization has been also discussed.