Study on Strain-Induced Crystallization of Natural Rubbers from Guayule and Rubber Dandelion

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Thesis Abstract

Because of the biosecurity and biodiversity problems of natural rubber (NR) from *Hevea brasiliensis*, studies on other rubber yielding plants, i.e., guayule and rubber dandelion have been focused. Strain-induced crystallization (SIC) has been well known as an indispensable function for *Hevea* NR. In order to determine their suitability as alternatives to *Hevea* NR, characteristics of SIC for sulfur crosslinked guayule and dandelion NRs were investigated using quick *in situ* simultaneous synchrotron time-resolved wide-angle X-ray diffraction/tensile measurements for the first time in this study. By comparing with sulfur cross-linked *Hevea* NR, the SIC of cross-linked dandelion NR was comparable to that of cross-linked *Hevea* NR. However, cross-linked guayule NR showed a superior SIC upon high stretching to cross-linked dandelion and *Hevea* NRs. This were presumably due to the lower non-rubber components particularly a lack of proteins leading the less branched physical network structure in guayule NR, compared to other NRs. In addition, a comparative SIC study between cross-linked guayule NR and isoprene rubber suggested that non-rubber components in guayule NR, which formed additional cross-linked sites and its high regularity of *cis*-1,4-polyisoprene configuration accelerated the SIC of cross-linked guayule NR. From the new points of view of SIC, the roles of non-rubber components on characteristic SIC of cross-linked guayule and dandelion NRs were apparently detected, probably relating to the different aggregation degrees of non-rubber components between the NRs. The results of DMA and Mullins effect also supported this hypothesis. Interestingly, the higher-order structures of their physically aggregated non-rubber components were possibly proposed. The present observation in this study confirmed that both guayule and dandelion NRs are useful as alternatives of *Hevea* NR from the view point of SIC features. Nonetheless, the roles of physically aggregated non-rubber components must be taken into account as they are applied to rubber materials.