29 JUNE - 3 JULY
ACEX2026
RHODES · GREECE

19th International Conference on Advanced
Computational Engineering and Experimenting
29 JUNE – 3 JULY 2026 | RHODES, GREECE

ABSTRACT:

Impact of Oxidation on Strain-Induced Crystallization in Natural Rubber

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Strain-induced crystallization is one of the key mechanisms responsible for the outstanding mechanical properties of natural rubber. However, during service life, natural rubber can undergo oxidation, leading to changes in the macromolecular network and potentially altering its ability to crystallize under strain [1].

In this work, natural rubber samples were thermally oxidized in air in order to progressively modify their network structure. The evolution of the network was characterized using swelling experiments, tensile testing and ^{1}H double-quantum NMR. Strain-induced crystallization was followed by in situ X-ray diffraction during stretching [2]. The results show that oxidation strongly affects strain-induced crystallization. A decrease in crystallization ability is observed with increasing oxidation, which is detrimental for the mechanical performance of natural rubber. These results show that oxidation modifies the macromolecular network of natural rubber and strongly affects its ability to crystallize under strain.

This study was carried out in collaboration with M. Arhant (Ifremer), P. Sotta (IMP), C. Robin (Hutchinson), B. Fayolle (PIMM) and P.-A. Albouy (Laboratoire de Physique des Solides).

[1] Albouy, P. A., & Sotta, P. (2020). Draw ratio at the onset of strain-induced crystallization in cross-linked natural rubber. Macromolecules, 53(3), 992-1000.

[2] Le Gac, P. Y., Albouy, P. A., & Sotta, P. (2019). Strain-induced crystallization in a carbon-black filled polychloroprene rubber: Kinetics and mechanical cycling. Polymer, 173, 158-165.