Mystery of Natural rubber for sustainable materials, based on structural characterization studies.

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Natural rubber (NR) latex from *Hevea brasiliensis* is the most important bio-based-elastomers, exhibiting high green strength and outstanding cured rubber properties, originating from its microstructure, compared with synthetic analogs. NR and synthetic polyisoprene (IR) are highly stereo-regular structures mainly composed of *cis*-1,4 polyisoprene, while IR also has *trans*-1,4 and 3,4-isomers. Only NR contains non-rubber components (NRCs) such as phospholipids, proteins, carbohydrates, and inorganic salts. The NRCs in NR, especially proteins and phospholipids, and geometrical isomers, are responsible for the superior properties of NR over IR.

Therefore, a series of studies to decipher NR microstructure must be clarified first. The first part will be discussed on the structure of the ω-initiating and α-terminating end groups of fresh *in vivo* NR molecules compared to newly synthesized *in vitro* NR ones, using a high-resolution NMR and various analysis techniques. Additionally, surface analysis techniques were employed to explore the topology and develop the rubber particle model. The relationship between its typical microstructure and the biosynthesis pathway of NR molecule in the rubber tree in connecting with the unique properties will be presented. Our research strengthens customer confidence in Thai NR over synthetic rubber by establishing a quality standard, boosting NR consumption to compete in various rubber application industries, and offering struggles for NR as a sustainable industrial polymer.
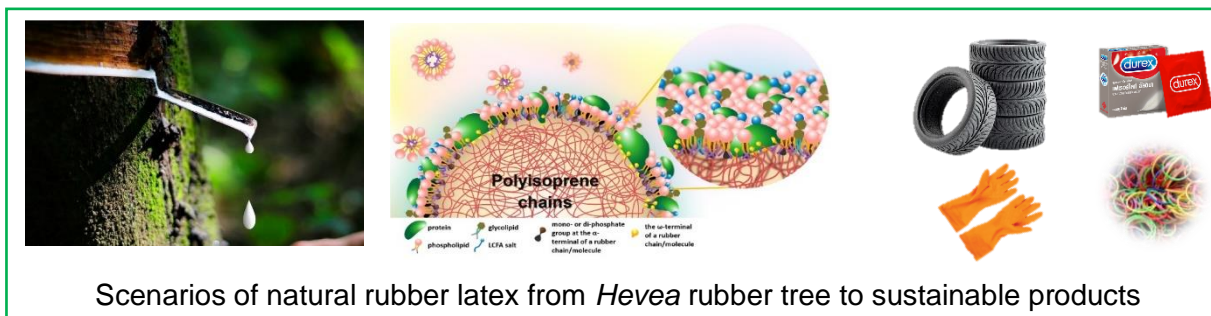
Scenarios of natural rubber latex from *Hevea* rubber tree to sustainable products