GREENER WAYS TO RUBBER VULCANIZATION

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ABSTRACT

Rubbers are highly deformable elastic polymeric materials with macromolecular chains linked together by chemical or physical bonds. Invented by Charles Goodyear, chemical cross-linking of rubbers by sulphur vulcanisation is the only method by which modern automobile tyres are manufactured. The formation of these cross-linked network structures leads to highly elastic properties, which substantially reduces the viscous properties of these materials. Here, we describe a simple approach to converting commercially available and widely used bromobutyl rubber (BIIR) into a highly elastic material with extraordinary self-healing properties without using conventional chemical cross-linking agents or vulcanising agents. Transformation of the bromine functionalities of BIIR into ionic imidazolium bromide groups results in the formation of reversible ionic clusters that exhibit physical cross-linking ability. The reversibility of the cluster formation facilitates the healing processes by temperature- or stress-induced rearrangements, thereby enabling a fully cut sample to retain its original properties after application of the self-healing process. Other mechanical properties, such as the elastic modulus, tensile strength, ductility, and hysteresis loss, are found to be superior to those of conventionally sulphur-cured BIIR. This simple and easy approach to preparing a commercial rubber with self-healing properties offers unique development opportunities in the field of highly engineered materials, such as tyres, for which safety, performance, and longer fatigue life are crucial factors.

In another work a multifunctional layered double hydroxide (LDH) is synthesised and applied as a cure activator in styrene butadiene elastomer crosslinked by a conventional sulphur based cure system. By this way the use of zinc oxide, which is supposed to be toxic for aquatic life would be completely avoided. This kind of layered material not only replaces zinc oxide but also offers several other functional features to the rubber composites like optical transparency even at higher loading of fillers, thermotropic character, reinforcement, and flame retardant behaviour.