

Mimicking the nature: Hook-and-loop adhesion systems for elastomers

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Nowadays, silica has become one of the most important fillers in the rubber industry. However, the polar character of its surface requires a chemical treatment before its incorporation to the less-polar or non-polar rubber matrix. Currently the most prevalent approach toward silica surface modification is the use of silane coupling agents which form strong covalent bonds between a silica and an elastomer. These bonds are relatively stiff and in most cases cannot be reconstructed after rupture. To overcome these disadvantages, a completely new approach was made. This new approach was inspired by the hook-and-loop velcro system widely spread in nature, which facilitates reconnectable mechanical links between two surfaces. The challenging task is to apply the hook-and-loop system in a macromolecular level by implementing physical entanglements for an alternative silica/elastomer interaction.

In this study a monohydroxy-telechelic butadiene oligomer was utilized as a backbone for the molecular “hook” synthesis. The hydroxyl group reacted with isocyanate group from triethoxyisocyanate silane in order to form reactive sites toward the silica surface. Whereas, double carbon-carbon bonds in vinyl position were utilized to attach side mercapto-terminated groups of significant steric hindrance providing sufficient entanglements with an elastomer matrix, acting as molecular “loops” (Fig. 1). This approach is a first step to implement the hook-and-loop system in a macromolecular level for the rubber industry and technology.

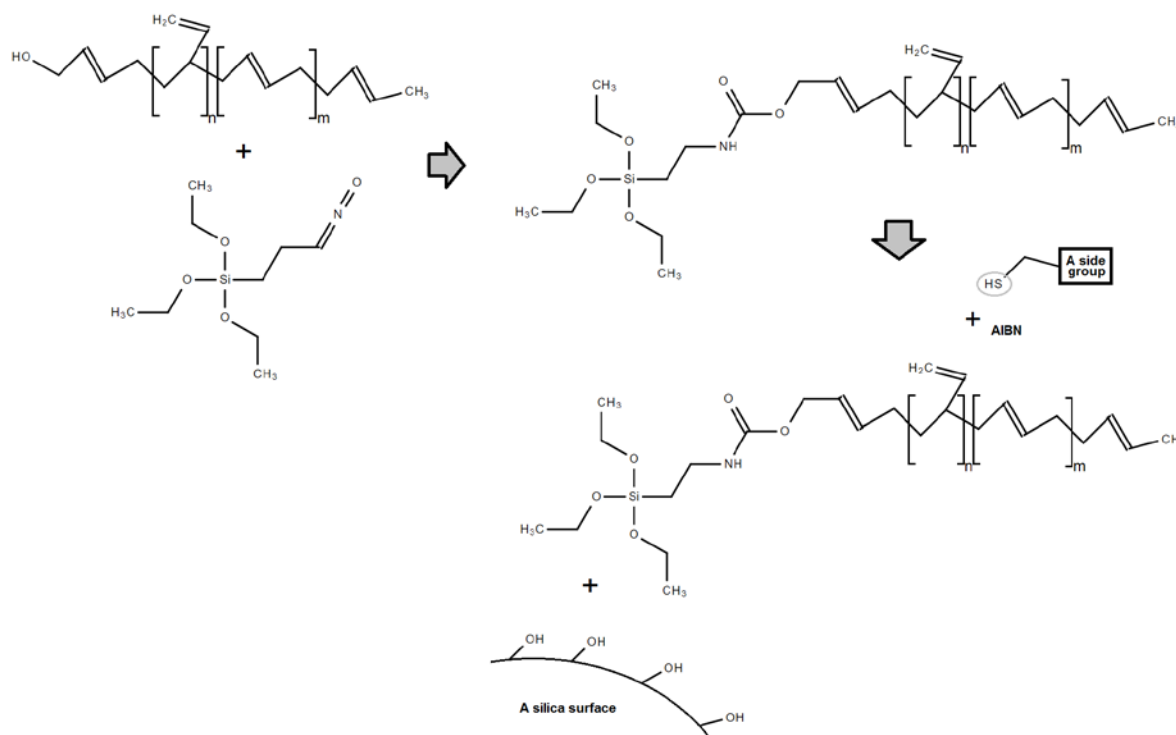


Figure 1: Scheme of the molecular “hook” synthesis and its attachments to a silica surface.