A thermo-reversible silicone elastomer with remotely controlled self-healing

Soft thermoplastic elastomers with increased durability and reliability are in high demand for a broad spectrum of applications. Silicone elastomers are soft and durable, but they are not thermoplastic in nature, and under extreme conditions such as high voltage or large deformations, reliability may also suffer. Thus, as a solution to these shortcomings, which are typical of silicone elastomers, it is natural to propose a thermo-reversible, self-healing, and recyclable silicone-based elastomer. Stimuli-responsivity is imparted to the silicone polymer by incorporating supramolecular 2-ureido-4[1H]-pyrimidone (UPy) self-assembling motifs via free radical polymerisation. Self-healing of the novel elastomer may be triggered by both direct and indirect heating, the latter by means of incorporating Fe$_3$O$_4$ particles into the elastomer and subsequent exposure to an alternating magnetic field. As a consequence of temperature responsiveness and high thermal stability, the elastomer is proven recyclable, by withstanding multiple reprocessing procedures with no substantial effects on the resulting properties. The synergy of these valuable characteristics makes this novel material a smart candidate for innumerable applications where soft and reliable elastomers are sought.

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