

Investigation of thermal degradation mechanisms of silicone elastomers

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Excellent thermal stability is one of the key features of polydimethylsiloxanes (PDMS), which make them suitable for a broad range of applications. These applications include for instance medical, automotive, and electronic devices, for which high temperatures are usually employed^[1]. Thermal resistance of silicones at high temperatures is due to the inherent strength and flexibility of the polymer backbone. In particular, the Si-O bond has high bond dissociation energy and low energy barrier to bond rotation. While the thermal degradation mechanism of linear PDMS is well understood^[2], the thermal degradation mechanism of cross-linked PDMS networks has not been studied yet. Therefore, the goal of this study is the elucidation of the thermal degradation mechanisms of cross-linked silicone elastomers (Figure 1) through the investigation of their thermal degradation behaviour and thermal degradation products. Thermogravimetric analysis (TGA) performed in inert atmosphere was carried out on PDMS networks synthesised with different stoichiometric ratios (Figure 2). In order to determine to which extent the thermal degradation is influenced by the sol fraction of the silicone elastomers, extraction of the samples in heptane was exploited to remove unreacted PDMS chains. Furthermore, long-term thermogravimetric measurements at constant temperatures were performed with the aim of investigating the degradation products of the thermally treated elastomers. Thermal degradation products recovered after thermal degradation were analysed with the combination of different techniques such as size exclusion chromatography, nuclear magnetic resonance and infrared spectroscopy.

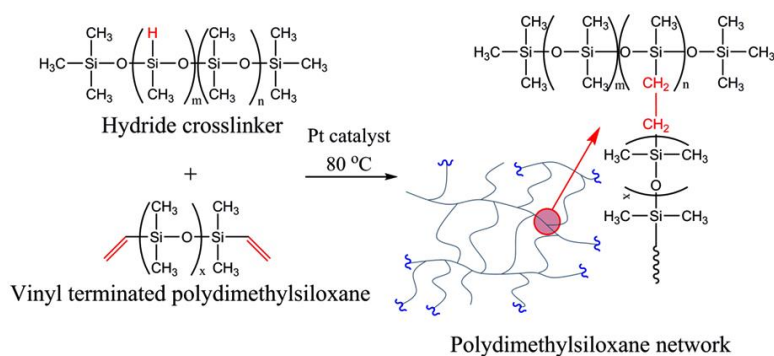


Figure 1. Schematic representation of the hydrosilylation reaction used to synthesize the silicone elastomers.

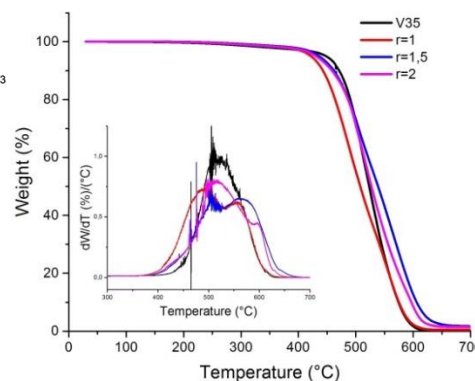


Figure 2. Comparison of the thermograms of the silicone elastomers with different stoichiometric ratios (r) and linear PDMS (V35). Inset plot: 1st derivative of the weight loss curves.

[1] K. Chenoweth, S. Cheung, A. C. T. van Duin, W. A. Goddard III, E. M. Kober, *J. Am. Chem. Soc.* **2005**, 127, 7192-7202.

[2] G. Camino, S. M. Lomakin, M. Laguard, *Polymer* **2002**, 43, 2011-2015.