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Molecular Description of Yield in Densely Crosslinked Epoxy Thermosets SANDIPAN CHATTARAJ, Centre for Research in Nanotechnology and Science, Indian Inst of Tech-Bombay, PRITA PANT, Metallurgical Engineering and Materials Science, Indian Inst of Tech-Bombay, DNYANESH PAWASKAR, Department of Mechanical Engineering, Indian Inst of Tech-Bombay, HEMANT NANAVATI, Department of Chemical Engineering, Indian Inst of Tech-Bombay —
In densely crosslinked networks, macroscopic yield is a transition from deformations of bond lengths and angles, to cooperative deformation of multiple effective network chains via bond torsions. In this work, we examine this yield in terms of the "activation number", ν, of microscopic effective chains between crosslinks. ν is the number of effective network chains, in one Eyring activation volume, V*. It is thus a measure of the number of network chains activated at yield, for cooperative deformation. Microcompression experiments have been performed on SU-8 micropillars, to determine its V* value. SU-8 is an important epoxy thermoset, which is used extensively in the microelectronics industry, in microfluidics and microelectromechanical systems (MEMS). The effective chain length based on Arruda and Boyce's 8-chain model, compares well with the rms length, obtained by chain conformer analyses. We find that $\nu \sim$ 2-4, at room temperature, for DGEBA-based epoxies including SU-8 and DGEBA-amine networks, over a range of network junction functionalities and V*. That ν corresponds very well with the reduced temperature, T/Tg, also demonstrates its viability as a molecular descriptor of yield in densely crosslinked thermosets.

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