EXTRAPOLATING THE DEFORMATION BEHAVIOR OF RUBBER TO HIGH RATES AND HIGH PRESSURES

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By definition, the term rubber comprises any flexible-chain, amorphous polymer above its glass transition temperature. However, T_g is rate dependent, and at sufficiently high rates rubbers exhibit glassy behavior. This well-known effect is exploited in various applications of elastomers, such as tire treads and acoustic tiles. Since commercial instruments are limited to low frequencies (< 100 s^{-1}), characterizing the mechanical properties of rubber at high strain rates commonly relies on extrapolations based on the time-temperature superposition principle. As commonly practiced, this procedure is fundamentally wrong and can lead to substantial errors; moreover, it is usually limited to low strains.

We have developed an instrument capable of measuring the mechanical response of rubber uniaxially deformed at rates approaching 1000 s^{-1} at strains to failure. The instrument is being used to test elastomers for applications involving high strain and high strain rates.