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Mechanics of Rubberlike Solids

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The lecture begins with an overview of the large deformation stress-strain response of rubberlike solids based on experimental observations, in particular of vulcanised natural rubber. First, experimental results that characterize the elastic behaviour of rubber are described. This is followed by illustrations of how the behaviour departs from the purely elastic; we examine stress softening associated with the Mullins effect, and the different degrees of stress softening for different rubbers are highlighted. Other inelastic effects such as hysteretic stress-strain cycling following pre-conditioning of the material (to remove the Mullins effect) are also described. Different approaches to modelling these behaviours on the basis of the isothermal phenomenological theory of elasticity and inelasticity are then described in detail and the quality of the comparison between theory and experiment is discussed. Finally, we discuss recent theoretical work concerning the coupling of mechanical and magnetic effects in so-called magneto-sensitive elastomers, which are being used as active components in various applications where the mechanical stiffness of the material can be changed rapidly by the application of a suitable magnetic field.

View the extended summary