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In-plane mechanics of soft architectured fibre-reinforced silicone rubber membranes

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Abstract

Silicone rubber membranes reinforced with architectured fibre networks were processed with a dedicated apparatus, allowing a control of the fibre content and orientation. The membranes were subjected to tensile loadings combined with continuous and discrete kinematical field measurements (DIC and particle tracking). These tests show that the mechanical behaviour of the membranes is hyperelastic at the first order. They highlight the influence of the fibre content and orientation on both the membrane in-plane deformation and stress levels. They also prove that for the considered fibrous architectures and mechanical loadings, the motion and deformation of fibres is an affine function of the macroscale transformation. These trends are fairly well described by the micromechanical model proposed recently in Bailly et al. (*JMBBM*, 2012). This result proves that these materials are very good candidates for new biomimetic membranes, *e.g.* to improve aortic analogues used for *in vitro* experiments, or existing textiles used for vascular (endo)prostheses.

Key words: Micro-mechanical model, Tensile tests, Biomimetism, Fibre-reinforced membrane, Anisotropy, Material design, Silicone rubber

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