# The Role of Viscoelasticity in the Mechanical Modelling of Rubbers

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**Abstract.** Increasing attention has been given to fuel cell technology in order to replace the internal combustion engines in transportation applications. Thin stamped bipolar plates (BPPs) are viewed as a promising alternative to the traditional graphite BPPs in proton exchange membrane fuel cells. Since the BPPs are the primary component of this technology, comprising most of the cost, special attention must be given to the manufacturing process. Accordingly, the rubber pad forming has been adopted in the manufacturing of thin stamped BPPs. Currently, the adoption of simulation tools to design and optimize the process is common during the project stage. Thus, in addition to the modeling of the elastoplastic behavior of the metallic sheet, this forming process requires the modelling of the mechanical behavior of the rubber material, which is both elastic and viscous. Although most of the hyperelastic material models are simple to apply and analyze, the modeling of the viscoelastic behavior is significantly more complex. The main objective of this study is to evaluate the importance of the viscous effect on the global behavior of two different polyurethanes. Uniaxial compression and stress relaxation tests are carried out both experimentally and numerically, considering three loading velocities. The hyperelastic behavior is described by the Mooney-Rivlin model, while the viscoelasticity is modelled by a series of Maxwell elements. The results show that the viscous effect can be neglected in the numerical simulation of the rubber pad forming.