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MULTI-SCALE IN-SITU EXPERIMENTS AS BASIS FOR CONTINUUM MODELLING OF POLYMERS

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A firm understanding of the coupling between the deformation on different scales within a material is key when formulating multi-scale constitutive models. In many polymers, the macroscopic deformation is, to a large extent, dictated by the underlying molecular structure and how this evolves during loading. To gain information about the behaviour of the molecular structure during deformation, non-destructive methods such as X-ray scattering can be utilised. However, scattering experiments give indirect information about the microstructure and appropriate modelling tools are required to interpret the data. Moreover, many polymer materials often exhibit heterogeneous deformation phenomena at different length scales, rendering boundary measures insufficient to fully describe the material behaviour and full-field measuring techniques, such as digital image correlation (DIC) and spatially resolved -ray scattering are required.

This work will present an experimental protocol combining *in-situ* mechanical loading and full-field deformation measurements using DIC with X-ray scattering that enables deformation to be measured simultaneously over a wide range of length-scales, cf. [1]. It will be shown that using this technique it is possible to investigate the coupling of deformation phenomena observed at different scales. Moreover, the work will present modelling tools that utilise the information from the advanced multi-scale experimental technique to formulate constitutive models for polymers on the continuum scale.

REFERENCES

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