Micromechanics and plasticity in silicate glasses

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Abstract

Our understanding of the intrinsic mechanical resistance of silicate glasses is poor [1]. To make progress in this direction, we are currently exploring the potential relation between local plasticity and intrinsic strength [2]. After a short introduction on the experimental difficulties connected to the brittle and amorphous nature of the material, I will present micromechanics experiments which we have designed to characterize the local scale plastic response of silicate glasses in a more quantitative manner [3], and the more realistic constitutive models which we have derived therefrom [4]. The analysis of indentation cracking as a function of glass composition will be considered as an example of application.

[1] Wondraczek, L. et al. (2011) Advanced Materials 23, 4578--4586.

[2] Marsh, D. (1964) Proc. R. Soc. London, Ser. A 282, 33--43.

[3] A. Perriot et al. (2006) J. Am. Ceram. Soc. 89, 596-601 ; Lacroix, R. et al. (2012) Acta Mater. 60, 5555—5566 ; Kermouche, G. et al. (2016) Acta Materialia 114, 146--153.

[4] Kermouche, G. et al. (2008) Acta Mater. 56, 3222—3228 ; Molnar, G. et al. (2016) Acta Materialia 111 129-137 ; Molnar, G.et al. (2017) Mechanics of Materials 114, 1-8.

Biographical sketch

After a PhD on solid state physics and antiferromagnetism at Orsay university, Etienne Barthel joined the CNRS/Saint-Gobain laboratory near Paris, where he developed fundamental studies of surface mechanics and interfaces in connection with industrial products and processes. His major centers of interest were adhesion, thin films, and plasticity of silicate glasses. Recently, he started working in the field of soft matter at the Science and Engineering of Soft Matter laboratory (SIMM/ESPCI) with special focus on dissipative line dynamics, in relation with either wetting or adhesion of soft polymers.