Multi-scale analysis in elasto-viscoplasticity coupled with damage

Serge Kruch *, Jean-Louis Chaboche

ONERA, DMSM, 29, Av. Division Leclerc, B.P. 72, 92322 Chatillon Cedex, France

1. Introduction

The increasing capabilities of experimental techniques, applied to the mechanics of materials field, allow achieving precise information from the macroscopic scale, i.e. the scale of the component, down to the atomic scale. However, pretend to analyze the macroscopic behavior of a structure starting from the molecular dynamics theory, jumping to the dynamics of dislocations (Groh et al., 2009; Gao et al., 2010) and finally calculating the plastic field on each integration point of the overall structure, is today unrealistic (McDowell, 2008, 2010). Thus, it is important to select the right information for the right purpose from the experimental data (Lissenden, 2010).

In the context of the modeling of plasticity coupled with damage, it is useful to integrate experimental observations obtained at the microscopic scale in order to propose more realistic constitutive equations. An important step is the definition of the representative volume element (RVE) (Cailletaud et al., 2003), which must be sufficiently large to be representative of the microstructure and sufficiently small not to be influenced by macroscopic mechanical gradients. For many microstructures, this RVE will be a set of sub-phases, each of them being representative of a particular geometrical or mechanical property.