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Identification of the micro-plasticity mechanisms at the origin of self-heating under cyclic loading with low stress amplitude

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Abstract — The aim of the present work is to study the mechanisms at the origin of the two self-heating regimes under cyclic loading observed for stress amplitudes lower than the conventional yield stress. To achieve this objective, several different and complementary microscopic observation techniques have been performed: optical microscopy, Scanning Electron Microscopy (SEM) and Atomic Force Microscopy observations and Electron BackScatter Diffraction (EBSD) measurements have been carried out on the surface of several specimens after cyclic loading. All the results presented hereafter have been obtained on an HSLA (*i.e.*, High Strength Low Alloy) commercial steel.

Keywords — High Cycle Fatigue, Dissipative mechanisms, Persistent Slip Bands, Optical microscopy, Scanning Electron Microscopy, HSLA steel.

1. Introduction

Traditionally, the determination of High Cycle Fatigue (HCF) properties of metallic materials is performed by using several tens of specimens (e.g., around thirty). A classic fatigue test is carried out under load control conditions and consists in applying a given cyclic loading, with a constant stress amplitude and constant mean stress, until failure. Therefore, a classic fatigue test campaign is very time-consuming and, for example, requires at least three weeks of tests at a loading frequency of 30 Hz. Such a run-duration for the determination of fatigue properties has become less compatible with

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