

Infrared thermography method to estimate fretting crack initiation length with respect to grain size

H. Lannay¹, S. Fouvry¹, B. Berthel¹, C. Gandiolle², J. Neggers²

¹Laboratoire de Tribologie et Dynamique des Systèmes, Ecole Centrale de Lyon, Ecully, France

²Laboratoire de Mécanique Paris-Saclay, CentraleSupélec, Gif-sur-Yvette, France

hugo.lannay@ec-lyon.fr

Abstract

The phenomena of fretting and fatigue can be observed in many industrial applications and are the reason behind severe damage in several metal pieces. Indeed, fretting creates a stress concentration that leads to crack nucleation and the fatigue load opens that crack until the complete fracture. To provide lifetime predictions of metal pieces under fretting-fatigue loading, we have to understand the crack nucleation process and more specifically the critical crack initiation length. However, there is no consensus in the literature on this question (first defect, grain size, El Haddad parameter, ...?) So, the objective of this specific study is to understand the link between fretting crack nucleation and microstructure in order to resolve this question of the critical crack nucleation size. For this purpose, two series of experiments are conducted: the first one involves cylinder/plane fretting tests to trace the evolution of the crack length as function of tangential load amplitude (Figure 1). The second one uses the infrared thermography method to determine the crack nucleation threshold in terms of tangential load. With these data, it is possible to estimate the crack initiation length for each grain size. Finally, a link with the critical distance – evaluated by inverse method – as a function of grain size is established.

Keywords: Fretting; Infrared thermography; Crack initiation; Microstructure; Critical distance

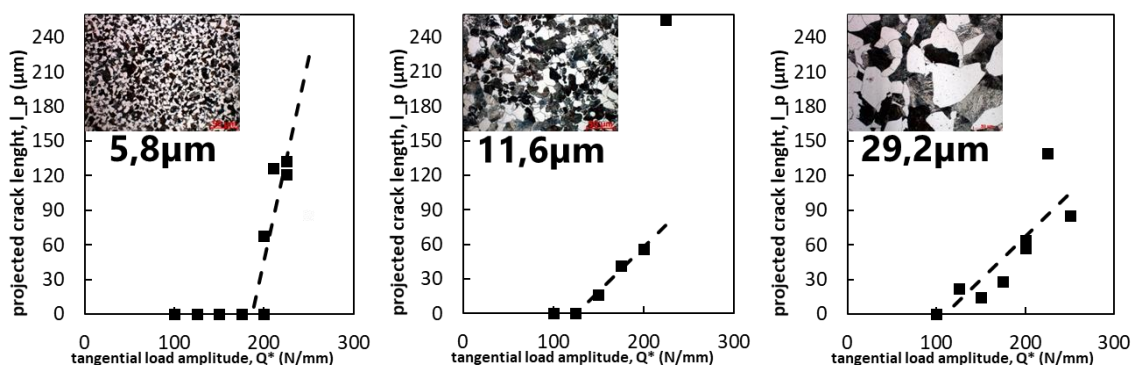


Figure 1. Projected crack length as function of the tangential load amplitude in the case of cylinder/plane fretting tests for three different grain sizes (XC38 steel, R=40mm, L=8mm, P=4000N)