FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE D COIMBRA

CEMMPRE
CENTRO DE ENGENHARIA MECÂNICA, MATERIAIS E PROCESSOS

Centre for Mechanical Engineering, Materials and Processes

CEMMPRE

PROPOSTA DE PLANO DE DOUTORAMENTO/DOCTORAL PLAN PROPOSAL

(a ser redigido em Inglês / to be filled in English)

ORIENTADOR(A)/SUPERVISOR: Fernando Jorge Ventura Antunes; Diogo Mariano Simões Neto

GRUPO/GROUP: A

ORIENTADOR(A)/SUPERVISOR: Ana Sofia Figueira Ramos

GRUPO/GROUP: B

LOCAL DE REALIZAÇÃO DO TRABALHO/PLACE OF WORK: DEM FCTUC

TÍTULO DO PLANO DE DOUTORAMENTO/TITLE OF THE DOCTORAL PLAN: Linking Fatigue Crack Growth to Microstructure

RESUMO/SUMMARY (max. 300 words total)

Objetivo/Objectives:

Fatigue is the main failure mechanism in components submitted to cyclic loads. In particular, for the aerospace industry it is vital to know the length of the cracks as a function of the number of cycles (or flights). Fast development of new metallic alloys and improvement of existing ones require understanding the relationship between microstructure and crack tip mechanisms responsible for fatigue crack growth. The main mechanism is cyclic plastic deformation, but additional ones are environmental damage, and growth and coalescence of microvoids. The microstructural parameters include grain size, as well as size and type of precipitates and intermetallic particles.

The main objective consists in establishing links between microstructure and crack tip mechanisms, and between these mechanisms and fatigue crack growth rate.

Resultados Esperados/Expected Results:

1. Submit metallic materials to different heat treatments, which will result in different microstructures. The alloys will be characterized by optical and scanning electron microscopy (SEM). Transmission electron microscopy (TEM) analyses will be done to study the distribution of precipitates, intermetallic particles, and microvoids inside the grains and along grain boundaries. TEM electron diffraction will allow precipitates/intermetallic particles to be identified.

2. Evaluation of mechanical properties, including low cycle fatigue tests needed to develop materials models. Nanoindentation tests will also be performed. Hardness and Young modulus distribution maps should reflect materials microstructure. Fatigue crack growth will be studied under constant and variable amplitude loads using non-linear crack tip parameters as crack driving force. The fracture surfaces will be analyzed by SEM to identify the main crack growth mechanisms. Fatigue specimens prepared by additive manufacturing (AM) will also be considered. Microtomography of AM specimens will be carried out to analyze defects non-destructively.

3. Establishment of microstructure/crack tip mechanisms and crack tip mechanisms/fatigue crack growth relationships. The metallurgical character of fatigue crack growth will be highlighted.

Programa Doutoral/Doctoral Program	**Ordenação por ordem de preferência/**Sorting in order of preference
Engenharia Mecânica/Mechanical Engineering	**1**
Engenharia Química/Chemical Engineering	**2**
Engenharia Biomédica/Biomedical Engineering	**3**
Biociências/Biosciences	**4**