Fracture failure analysis of ASTM F139 stainless steel under combined corrosion and fatigue mechanisms

Eurico F. Pieretti[1], Tomaz P. Leivas[2], Maurício D. M. das Neves[1]

[1]Instituto de Pesquisas Energéticas e Nucleares(IPEN/CNEN), Av. Prof. Lineu Prestes 2242, São Paulo-SP, 05508-000, Brazil

[2] Instituto de Ortopedia e Traumatologia do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (IOT/HCFMUSP), Rua Dr. Ovídio Pires de Campos 333, São Paulo – SP, 05403-010, Brazil

Abstract

Fractures resulting from wear and fatigue process have been identified as the main causes of failure in biomaterials, especially in implants that act in place of bone or other hard tissue, as they are subject to conditions involving severe cyclic loadings. In the case of biomaterials, the types of failures mentioned above must also be evaluated under the effect of degradation or corrosion, because they are in direct contact with body fluids. The present research analyzed the fatigue induced by corrosion fracture of an orthopaedic implant made by austenitic ASTM F139 stainless steel. The morphology, compositions of the interfaces and subsequent corrosive pitting were characterized with field emission gun - scanning electron microscopy (FEG-SEM) coupled with energy dispersive spectroscopy (EDS). Stress concentration and inclusions were the main reasons of failure, because at these regions cracks and pitting initiate and propagates autocatalytically.

Key-words: Fatigue-corrosion, biomaterials, ASTM F139 SS, orthopaedic implants.