



22nd European Conference on Fracture - ECF22

LOADING AND ENVIRONMENT EFFECTS ON STRUCTURAL INTEGRITY

Book of Abstracts

Belgrade, Serbia, 26 - 31 August, 2018

HISTORY OF ECF CONFERENCES

- ECF 21 *Fracture and safety*, Catania, Italy, Jun 20-24, 2016
- ECF 20 *Fracture at all scales*, Trondheim, Norway, Jun 30-Jul 4, 2014
- ECF 19 *Fracture mechanics for durability, reliability and safety*, Kazan, Russia, Aug 26-31, 2012
- ECF 18 *Fracture of materials and structures from micro to macro scale*, Dresden, Germany, Aug 29-Sep 03, 2010
- ECF 17 *Multilevel approach to fracture of materials, components and structures*, Brno, Czech Republic, Sep 2-5, 2008
- ECF 16 *Failure analysis of nano and engineering materials and structures*, Alexandroupolis, Greece, Jul 3-7, 2006
- ECF 15 *Advanced fracture mechanics for life and safety assessments*, Stockholm, Sweden, Aug 11-13, 2004
- ECF 14 *Fracture mechanics beyond 2000*, Krakow, Poland, Sep 8-13, 2002
- ECF 13 *Fracture mechanics: applications and challenges*, San Sebastian, Spain, Sep 6-9, 2000
- ECF 12 *Fracture from defects*, Sheffield, United Kingdom, Sep 14-18, 1998
- ECF 11 *Mechanisms and mechanics of damage and failure of engineering materials and structures*, Poitiers, Futuroscope, France, Sep 3-6, 1996
- ECF 10 *Structural integrity: experiments, models and applications*, Berlin, Germany, Sep 20-23, 1994
- ECF 9 *Reliability and structural integrity of advanced materials*, Varna, Bulgaria, Sep 21-25, 1992
- ECF 8 *Behaviour and design of materials and structures*, Turin, Italy, Oct 1-5, 1990
- ECF 7 *Failure analysis – theory and practice*, Budapest, Hungary, Sep 19-23, 1988
- ECF 6 *Fracture control of engineering structures*, Amsterdam, The Netherlands, Jun 15-20, 1986
- ECF 5 *Life assessment of dynamically loaded materials and structures*, Lisbon, Portugal, Sep 17-21, 1984
- ECF 4 *Fracture and the role of microstructure*, Leoben, Austria, Sep 22-24, 1982
- ECF 3 *Fracture and fatigue*, London, United Kingdom, Sep 8-10, 1980
- ECF 2 *2nd European colloquium on fracture*, Darmstadt, Germany, Oct 9-11, 1978
- ECF 1 *1st European colloquium on fracture*, Compiègne, France, 1976

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Numerical simulation of fracture in Ti-6Al-4V alloy for orthopedic applications

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Abstract

The fracture behavior of implant Ti-6Al-4V alloy is essential for its service capability in orthopedic surgery. Therefore, it is very important to understand and predict the fracture resistance of this biomedical material. Although several micromechanical models have been developed for modeling the fracture behavior of metallic materials with ductile dimple fracture as predominant fracture mode, they have predominantly been applied to materials such as steels and aluminum alloys. Recently, efforts have been made to apply these micromechanical models to predict crack initiation and growth in two-phase titanium alloys. Due to the complex multiple fracture micromechanisms operative in these alloys, it is necessary to check the applicability of damage models on these materials. In the present study, the mechanical testing and numerical simulation are carried out to characterize the fracture behavior of an extra-low impurity (ELI) Ti-6Al-4V alloy solution treated below β transus temperature followed by water quenching in order to obtain the globular microstructure with 82 vol.% primary α and 18 vol.% β phase. The compact tension (CT) specimen is used for fracture testing. The crack tip opening displacement (CTOD) and strain distribution near the crack tip are measured on its surface by the digital stereometric method. The complete Gurson model (CGM) implemented in a finite element (FE) code ABAQUS is applied to predict the crack resistance (CTOD-R) curves and crack growth initiation (CTOD_i) values. A relatively good correlation between the experimental and results obtained by numerical simulation demonstrates the applicability of CGM for the prediction of fracture behavior in Ti-6Al-4V ELI alloy with given microstructure. The better agreement, in comparison with plane strain conditions, is achieved through a 3D $\frac{1}{2}$ symmetrical FE model with appropriate FE size. The microstructural effects on the fracture mechanics parameter and fracture modeling are discussed.

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Keywords: Titanium alloy, fracture mechanics, finite elements, modeling, complete Gurson model

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