

01-5 IUTAM Symposium on Analytical and Computational Fracture Mechanics of Non-homogeneous Materials, Cardiff University, UK, June 18-22 2001

a) Scientific Committee

Z.P. Bažant (USA), R. de Borst (Netherlands), L.B. Freund (USA, IUTAM repres.), K.-C. Hwang (PR China), A.R. Ingraffea (USA), B.L. Karihaloo (UK, Chairman), J.-B. Leblond (France), G. Maier (Italy), Z. Mroz (Poland), H.-B. Mühlhaus (Australia), J.R. Willis (UK).

b) Short summary of scientific progress achieved

This Symposium was convened to address topical issues in analytical and computational aspects of the fracture of non-homogeneous materials as they are approached by specialists in mechanics, materials science and related fields. The range of non-homogeneous materials was limited to those that are inhomogeneous at the macroscopic level and/or exhibit strain softening, covering materials such as rock, concrete, ceramics and composites on the one hand, and, on the other, those metallic materials whose ductile fracture is strongly influenced by the presence of inhomogeneities.

There were five days of invited presentations on fundamental research issues with many common features among seemingly disparate non-homogeneous materials. Presentations emphasized many aspects, including experimental observation, ranging from the role of inhomogeneities, interfacial fracture, scaling laws and non-local effects.

Micromechanical modeling, macroscopic analysis that reveals underlying micromechanisms of fracture, lattice modeling, and methods based on non-local and gradient theories were expounded.

A special feature of the Symposium was the opportunity provided to young researchers to make 15-minute presentations. Judging by the response of the participants the Symposium achieved its aims admirably.

c) Countries represented and number of participants

Australia (4), Austria (2), PR China (3), Denmark (4), France (5), Germany (4), Greece (1), Israel (3), Italy (6), Japan (4), Netherlands (4), Poland (3), Russia (5), Spain (1), United Kingdom (21), United States (9)

d) Publication of Proceedings of the Symposium

The Proceedings comprising reviewed Symposium papers will be published by Kluwer Academic Publishers by mid-2002 (Editor: B.L. Karihaloo).

e) Financial support

Financial support for the Symposium was generously provided by the following organizations:

- International Union of Theoretical and Applied Mechanics
- Innovation Centre of Welsh Development Agency (WDA)
- Cardiff University

f) Scientific program

Session 1

A. Kelly, *Poisson's number*.

Session 2

L. Banks-Sills, *Conservative integrals for calculating stress intensity factors in bimaterial bodies*.

H.L. Schreyer, *Features and ellipticity analysis of a discrete constitutive equation*.

D. Leguillon, *Finite fracture mechanics, Application to the onset of a crack at a bimaterial corner*.

D.H. Chen, K. Ushijima, *Elastic-plastic stress singularity near a bonded interface*.

D. Garagash, E. Detournay, *Viscosity-dominated regime of a fluid-driven fracture in an elastic medium*.

Session 3

L.N. McCartney, *Modeling failure mechanisms in laminated composites*.

A. Carpinteri, G. Ferro, G. Ventura, *The influence of fiber on the structural response of reinforced concrete beams*.

Y. Estrin, A.V. Dyskin, A.J. Kanel-Belov, E. Pasternak, *Materials with novel architectonics: assemblies of interlocked elements*.

G. Mishuris, G. Kuhn, *Asymptotics of elastic field near the tip of interface crack under nonclassical transmission conditions*.

Session 4

F.M. Borodich, *Scaling in multiple fracture and size effect*.

A.V. Dyskin, *Mechanics of fractal materials*.

M.M. Davydova, *Fractal aspects of fracture simulation*.

A. Feraille-Fresnet, A. Ehlacher, *Filling of a circular crack with two non-miscible fluids*.

V. Petrova, *Macro-microcrack interaction taking into account crack closure*.

Session 5

C. Atkinson, I. Bradford, *Effect of inhomogeneous rock properties on the stability of wellbores*.

H.B. Mühlhaus, L. Moresi, F. Dufour, *The interplay of material and geometric instabilities in large deformations of viscous rock*.

- H. Horii, E. Puntel, *Rate dependent softening law for shear crack and unstable crack growth in geological materials.*
- E. Pasternak, A.V. Dyskin, H.B. Mühlhaus, *Fractures and defects in Cosserat Continua modeling layered materials.*
- L. Germanovich, R. Chanpura, *Modeling hydrocarbon reservoirs by discontinuities in poroelastic material.*

Session 6

- J.F. Knott, *Cleavage fracture in "heterogeneous" steel microstructures.*
- D.A. Scarth, E. Smith, *Modeling delayed hydride cracking in zirconium alloys.*
- T. Cretegnny, E. Iesulauro, C.S. Chen, C. Myers, J. Sethna, A.R. Ingraffea, *Mixed continuum-atomistic modeling for crack growth in polycrystals.*
- J.P. Dempsey, *The viscoelastic fracture and indentation of sea ice.*

Session 7

- T. Belytschko, M. Moes, A. Gravouil, *Arbitrary cracks by the extended finite element method and level sets.*
- R. Lackner, H.A. Mang, *Modeling of early-age fracture of shotcrete: application to tunneling.*
- G. Cocchetti, G. Maier, X. Shen, *Simulation of hydraulic fracture along the concrete-rock interface in gravity dams.*

Session 8

- Z. Mroz, N. Bialas, *Modeling of progressive interface failure under monotonic and cyclic loading.*
- J. Frelat, J.B. Leblond, *Crack kinking from an initially closed interface crack in the presence of friction.*
- A. Corigliano, *Elasto-plastic interface laws for non-homogeneous materials: formulation, sensitivity analysis and parameter identification.*
- D. Zeng, N. Katsube, W.O. Soboyejo, *Analytical and discrete modeling of transformation toughening.*

Session 9

- R. Luciano, J.R. Willis, *Non-local constitutive response and associated boundary conditions for a randomly heterogeneous medium.*
- A. Needleman, *Dynamic crack growth along interfaces.*
- G. Borino, C. Polizzotto, *A thermodynamic plasticity formulation with local and non-local internal variables.*
- X. Zhang, Y.W. Mai, *Multi-scale energy release rate in dynamic crack growth of strain-softening materials.*

Session 10

- G.N. Wells, R. de Borst, L.J. Sluys, *A new numerical approach to strain localisation.*

P. Steinmann, D. Ackermann, F.J. Barth, *Material forces in computational fracture mechanics.*

A. Zervos, P. Papanastasiou, I. Vardoulakis, *Shear localization in thick-walled cylinders under internal pressure based on gradient elastoplasticity.*

Session 11

J. Fang, J.X. Wang, M. Li, C.Y. Xiong, J. Zhang, *Damage and fracture study of non-homogeneous materials by image correlation computations.*

R. Pyrz, *Fibre failure due to thermal residual stresses in model polymer based composites.*

A. Rabinovitch, V. Frid, D. Bahat, J. Goldbaum, *A new method to obtain crack surface areas from electromagnetic radiation emitted in fracture.*

E.K. Gamstedt, T.K. Jacobsen, B.F. Sørensen, *Determination of cohesive laws for materials exhibiting large scale damage zones.*

Session 12

F.J. Ulm, E.C. Silva, *Biochemomechanics of biological resorption processes in heterogeneous materials.*

J. Ozbolt, *Numerical study of mixed-mode fracture in concrete structures.*

A.D. Jefferson, *Thermodynamics of a multi component crack model.*

D. Pivonka, R. Lackner, H.A. Mang, *Failure assessment of anchor bolts by means of nonlinear finite element analysis.*

M. Cuomo, *An interface model for fibre reinforced concrete.*

Z. Mroz, T. Sadowski, S. Samborski, *Gradual degradation of initially porous polycrystalline ceramics subjected to quasi-static tension.*

Session 13

V. Tvergaard, *3D studies of ductile failure in particulate reinforced metals.*

C. Gonzalez, J. Llorca, *Modeling deformation and damage in particle-reinforced composites: the effect of superposed hydrostatic pressure.*

A. Delaplace, G. Pijaudier-Cabot, S. Roux, *Understanding failure of heterogeneous materials from the analysis of discrete disordered systems.*

Session 14

A.B. Movchan, V.V. ZalipaeV, *An asymptotic model of non-destructive testing for porous media.*

S.W. Yu, G.F. Wang, X.Q. Fen, Y.L. Kang, *Analysis of the effects of shear and rotation on the mechanical behaviour of interphase by using strain gradient theory.*

T.K. Jacobsen, B.F. Sørensen, E.K. Gamstedt, *Modeling of R-curves from measured bridging laws.*

E.I. Ryzhak, *Localized instability: what is it, and is it indispensable when possible?*

L.V. Nikitin, V.N. Odinstev, *Fracture of compressed gas bearing microinhomogeneous medium.*

Session 15

S. Roux, *Quasi-static crack propagation in brittle heterogeneous materials.*

G. Lilliu, J.G.M. van Mier, *Analysis of three-dimensional crack propagation in random lattice studies with particle overlay.*

N. Madhusudhan, T.N. Singh, *A novel technique for the generation of failure criteria for jointed rock.*

A. Pegushin, *Nonlinear wave propagation in porous materials.*

B.L. Karihaloo, R. Ince, A. Arslan, *An improved lattice model for fracture of concrete.*

Report composed by B.L. Karihaloo