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Edited by Anders E. Carlsson , Edwin R. Fuller, Jr. , John J. Mecholsky , Robin L. Blumberg Selinger

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Fracture—Instability Dynamics, Scaling, and Ductile/Brittle Behavior

Symposium held November 27-December 1, 1995, Boston, Massachusetts, U.S.A.

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*Invited Paper

PREFACE

This volume contains the papers that were presented at the 1995 MRS Fall Meeting in Symposium Q, entitled 'Fracture: Instability Dynamics, Scaling, and Ductile/Brittle Behavior.' The purpose of the symposium was to bring together the many communities that investigate the fundamentals of fracture, with special sessions on the ductile/brittle transition, fracture at interfaces, fracture in ceramics and composites, dynamic instabilities in crack propagation, and fractals and scaling in fracture. A full-day joint session was held with Symposium P, 'Materials Theory, Simulations, and Parallel Algorithms.'

What was most striking about the symposium was the rich variety of methods that investigators use to model fracture. At the most detailed level, *ab initio* techniques are used, for instance, to estimate the strength of adhesion at an interface as a function of local structure and composition. At the next level, classical molecular dynamics provide a close up view of a propagating crack in a two- or three-dimensional solid, at least over short length and time scales. Green's function methods provide a way to model the behavior of materials at the atomic scale in the static limit, with zero temperature and strain rate. At the mesoscale, defects such as dislocations may be modelled as point particles (in 2-D) or as line segments (in 3-D) with long-range interactions. The dislocation density may be approximated as a continuous function of position and time, or even treated as an order parameter in a statistical mechanical model. At larger length scales, finite element and continuum models are used to study mixed mode crack propagation, and bond network models are used to represent the behavior of fiber composites.

Experimental papers also emphasized a wide range of techniques for measuring the effects of fractures, ranging from fracture toughness measurements to atomic-force and scanning-electron microscopy. Major topics included impurity embrittlement, interfacial adhesion, the toughness of ceramics and composites, and the morphology of fracture surfaces. In connection with observations of fractal morphology, several papers showed that some fracture surfaces can be modelled as self-affine rather than self-similar; in each case, the surface has scaling properties, but in the former case the scaling perpendicular to the surface is different from that parallel to the surface. Another particularly exciting experimental technique presented was X-ray tomographic microscopy (XTM), which was used to image the interior of a three-dimensional sample undergoing ductile rupture at a material interface.

Thanks are due to Robb Thomson, who assisted in the planning of the symposium; to Heather Mayton, who provided priceless administrative assistance; to the MRS staff, who offered excellent logistical support; and to the 1995 MRS Fall Meeting Chairs, Michael J. Aziz, Leslie J. Struble, and Bernard T. Jonker.

The symposium was generously supported by the Office of Naval Research, and we are grateful to Scientific Officers Steven G. Fishman and Peter Reynolds for their support.

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