Symposium on

FAILURE MODES IN DYNAMIC FRACTURE

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Introduction

The focus of this symposium is the fracture of engineering materials under conditions of high rates of loading or rapid crack growth. The area of dynamic fracture mechanics has matured considerably over the past two decades, and there now exists a rich body of work on dynamic crack tip fields, solution of boundary value problems, experimental observation of dynamic crack phenomena, and computational simulations of the behavior of cracks under conditions of high rate of deformation. The traditional fracture mechanics approach, in spite of its strong theoretical foundations and phenomenal success in practice, does not deal directly with the connection between fracture characterizing parameters and the physical mechanisms of material separation that are operative during a fracture process. With the prospect of design of material microstructures for specific applications taking a prominent role in national research strategies, the relationship between mechanisms and bulk response of materials emerges as an issue of central importance. Thus, this symposium on dynamic fracture is intended to probe in a few directions where progress has been made.

Several different issues are addressed in the papers included in the symposium. One of these is the formation of shear bands under high rate conditions, typical of crack tip fields under impact loading or fast fracture. Circumstances under which shear bands can form in a ductile material, the temperature rise associated with sustained ductile shearing in the crack tip region, and the use of viscoplastic constitutive theory to model such phenomena are described. A second issue is based on the use of a constitutive model for the material of a fracturing solid which incorporates material separation by means of a realistic physical mechanism. This approach obviates the need for an additional postulate on material behavior in the form of a fracture criterion. The third issue is concerned with the growth and coalescence of microcracks in brittle materials under impact loading conditions in order to produce macroscopic failure.

The common thread of this work is to be found in the use of constitutive theories appropriate for high rates of deformation in materials, the observation of fracture response under high rates of straining, and the focus on physical mechanisms of failure.

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