

REPORT DOCUMENTATION PAGE

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MEMORANDUM FOR PRS (In-House/Contractor Publication)

FROM: PROI (STINFO)

08 Mar 2001

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-TP-2001-048**
Liu, C.T., "Investigating Near Tip Damage and Crack Growth Behavior in a Solid Propellant"
(VuGraphs)

JANNAF 34th Structures & Mechanical Behavior Subcommittee Meeting
(Cocoa Beach, FL, 26-30 Mar 2001) (Deadline: 09 Mar 2001)

(Statement A)

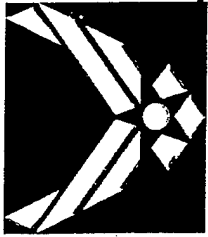
Investigating Near Tip Damage and Crack Growth Behavior in a Solid Propellant



Dr. C. T. Liu

**Principal Materials Research
Engineer**

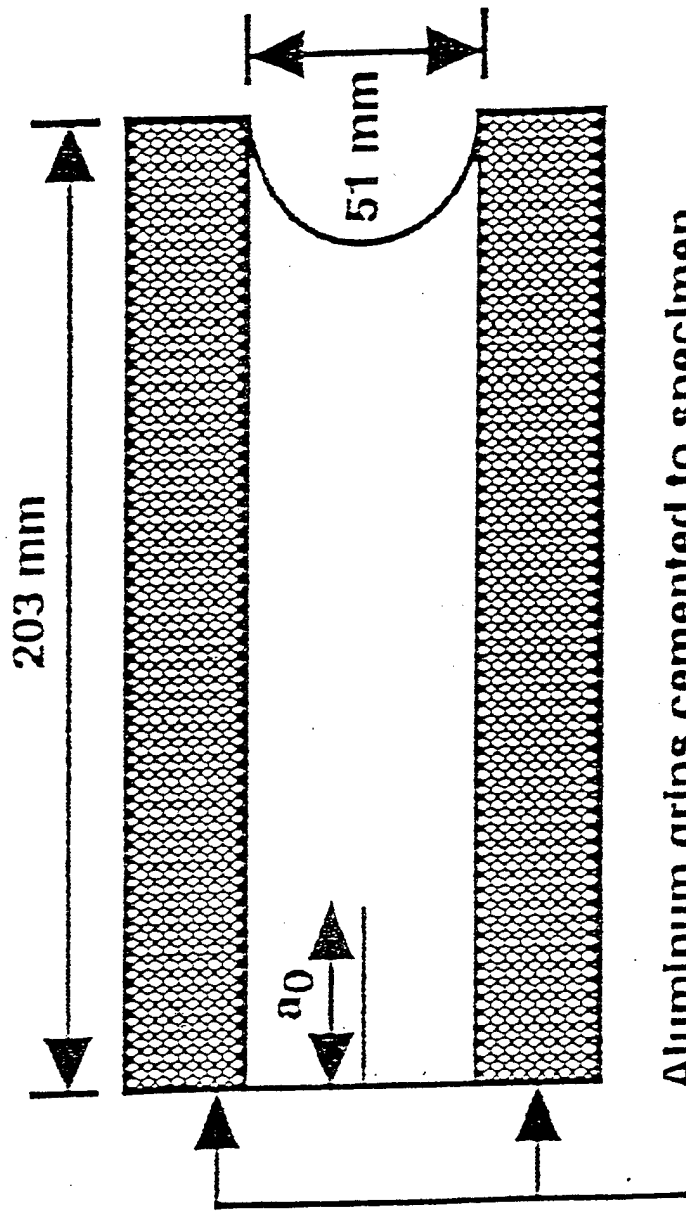
**Air Force Research
Laboratory**



Objectives



- Investigate the Local Damage Mechanisms Near the Crack tip in a Solid Propellant.
- Investigate the Effects of Local Damage on the Crack Growth Behavior under a Constant Strain Rate Condition.

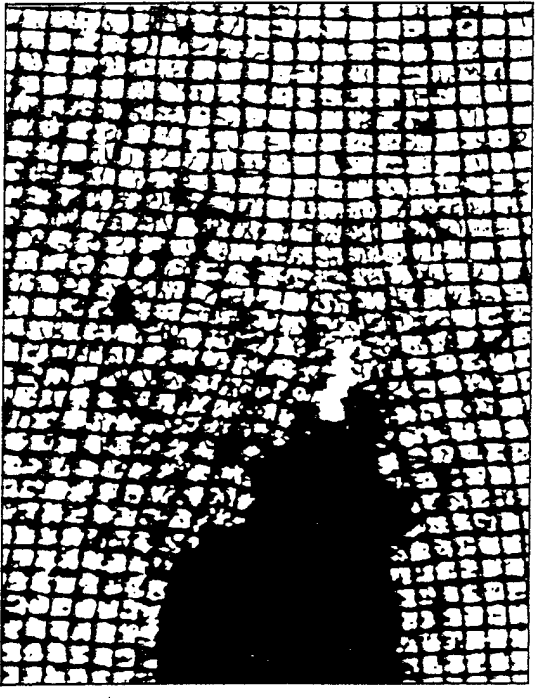
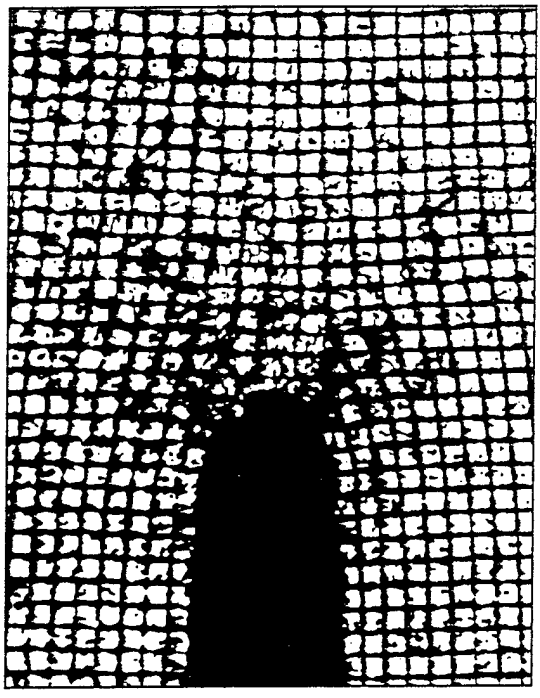
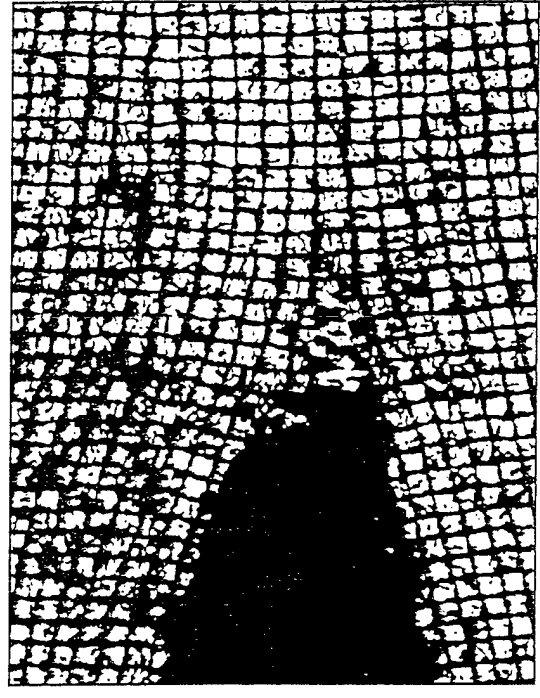
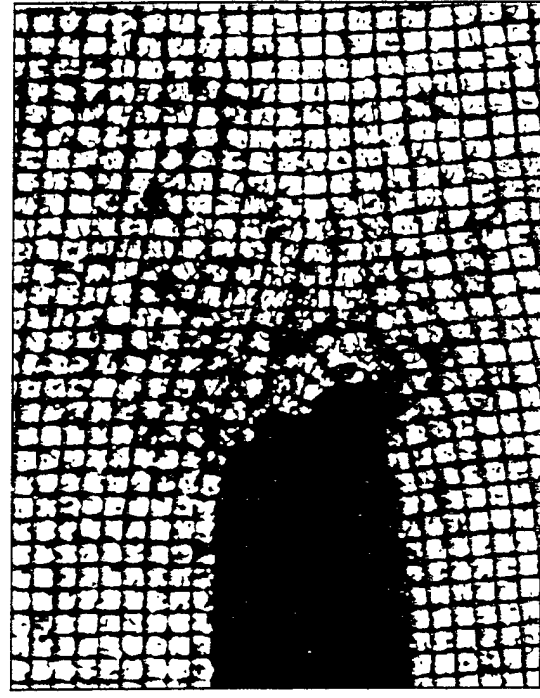


Aluminum grips cemented to specimen
Specimen thickness: 2.5 mm

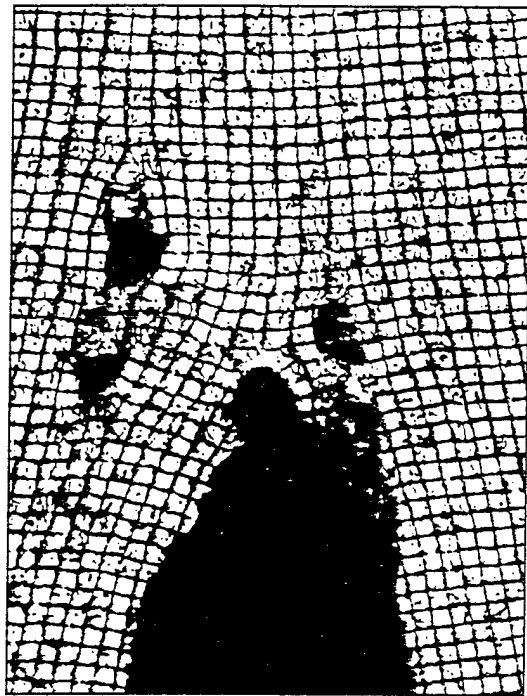
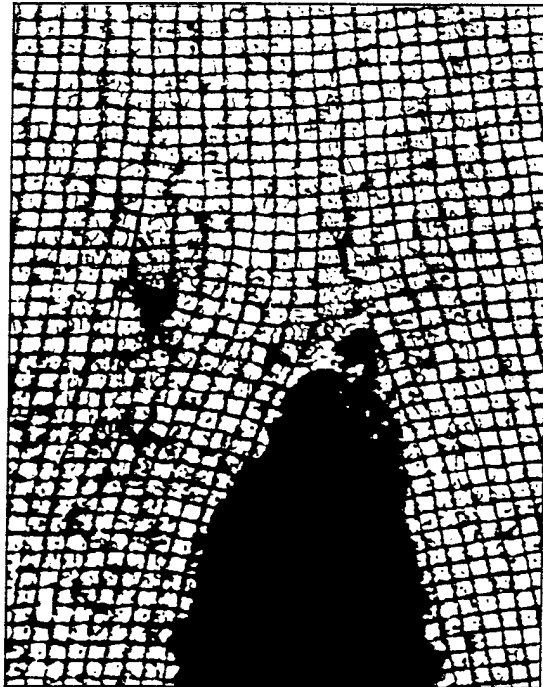
$$a_0 = 23\text{mm}$$

Specimen Geometry

Crack Tip Profiles



Crack Tip Profiles

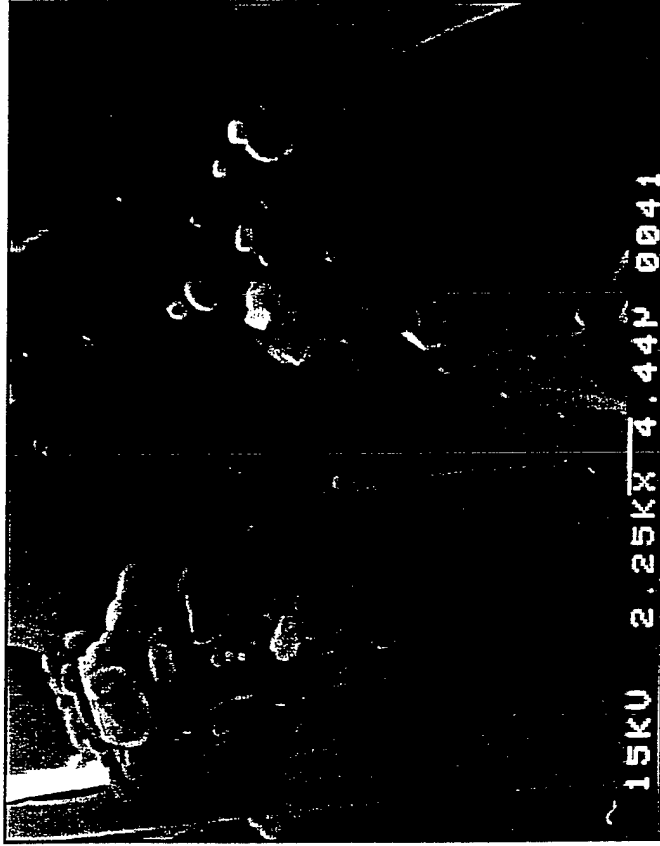
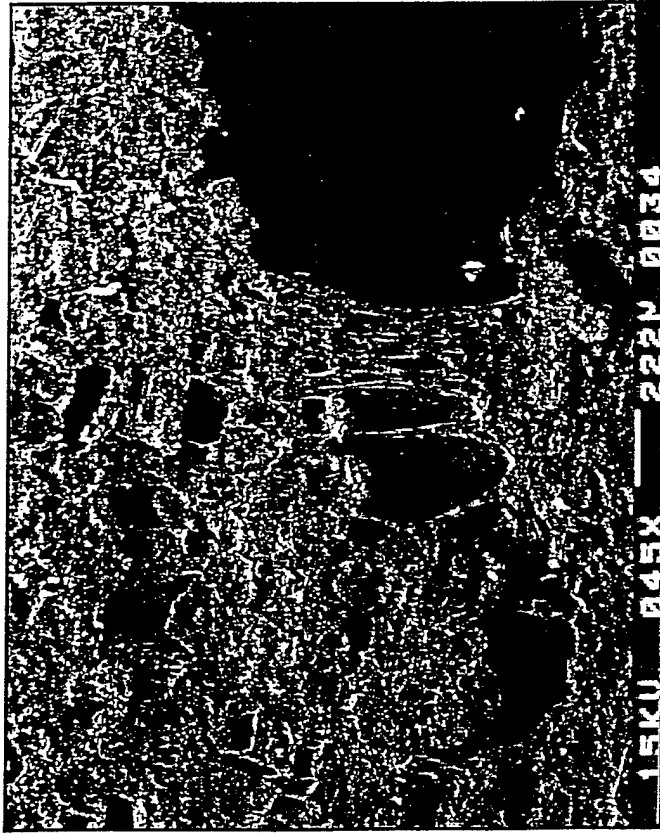


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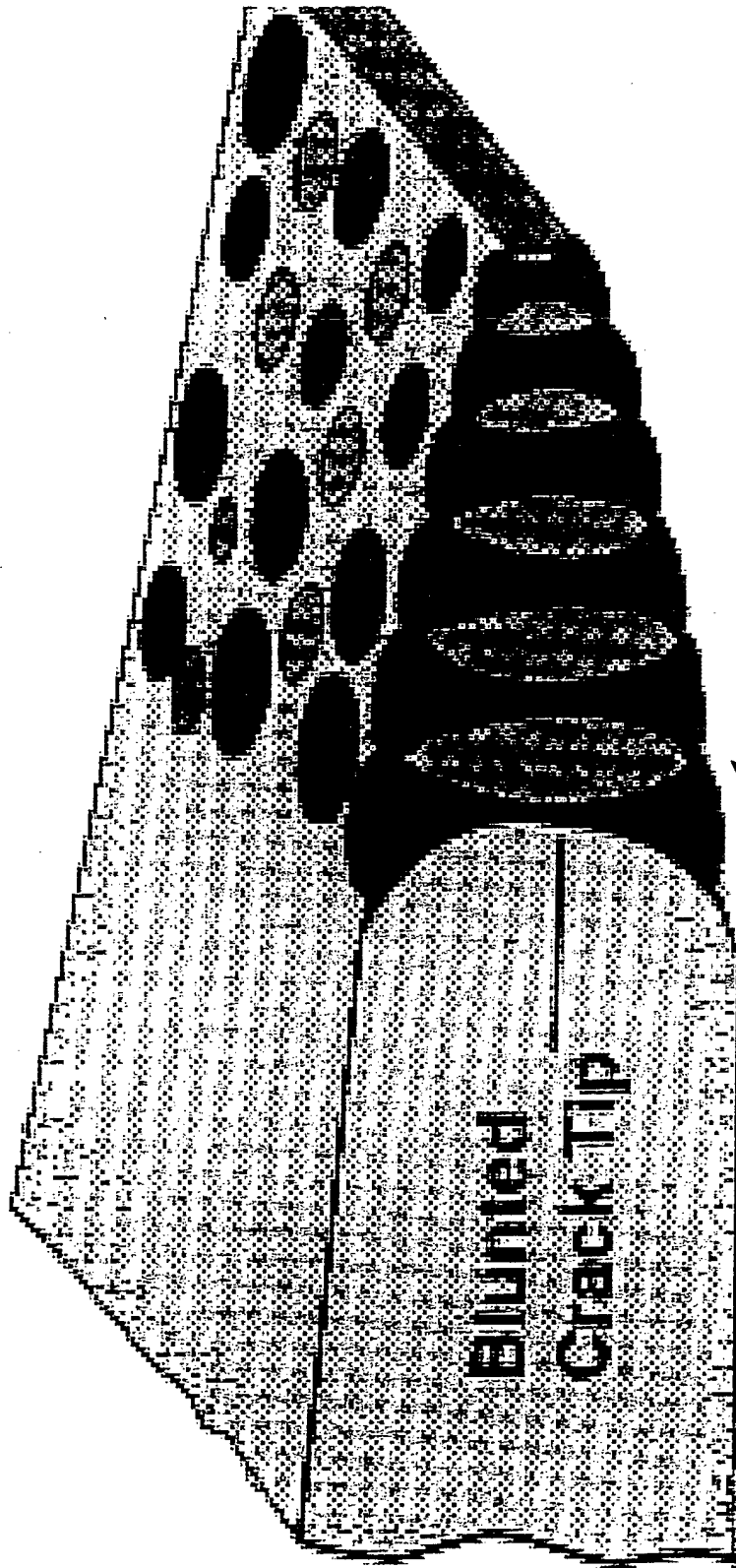


Damage Zone at Crack Tip





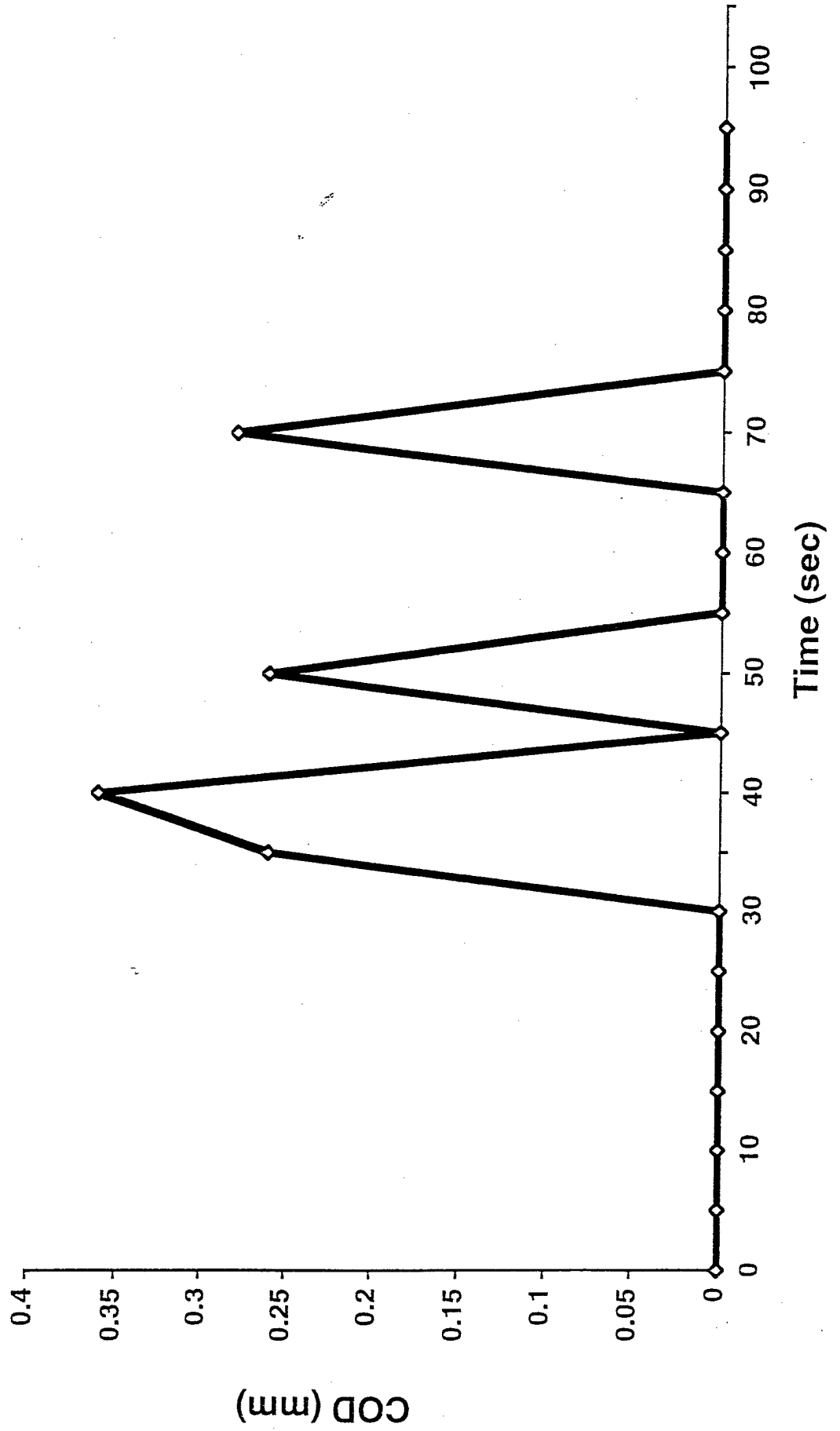
Crack Tip Damage Model



Highly Damaged Zone

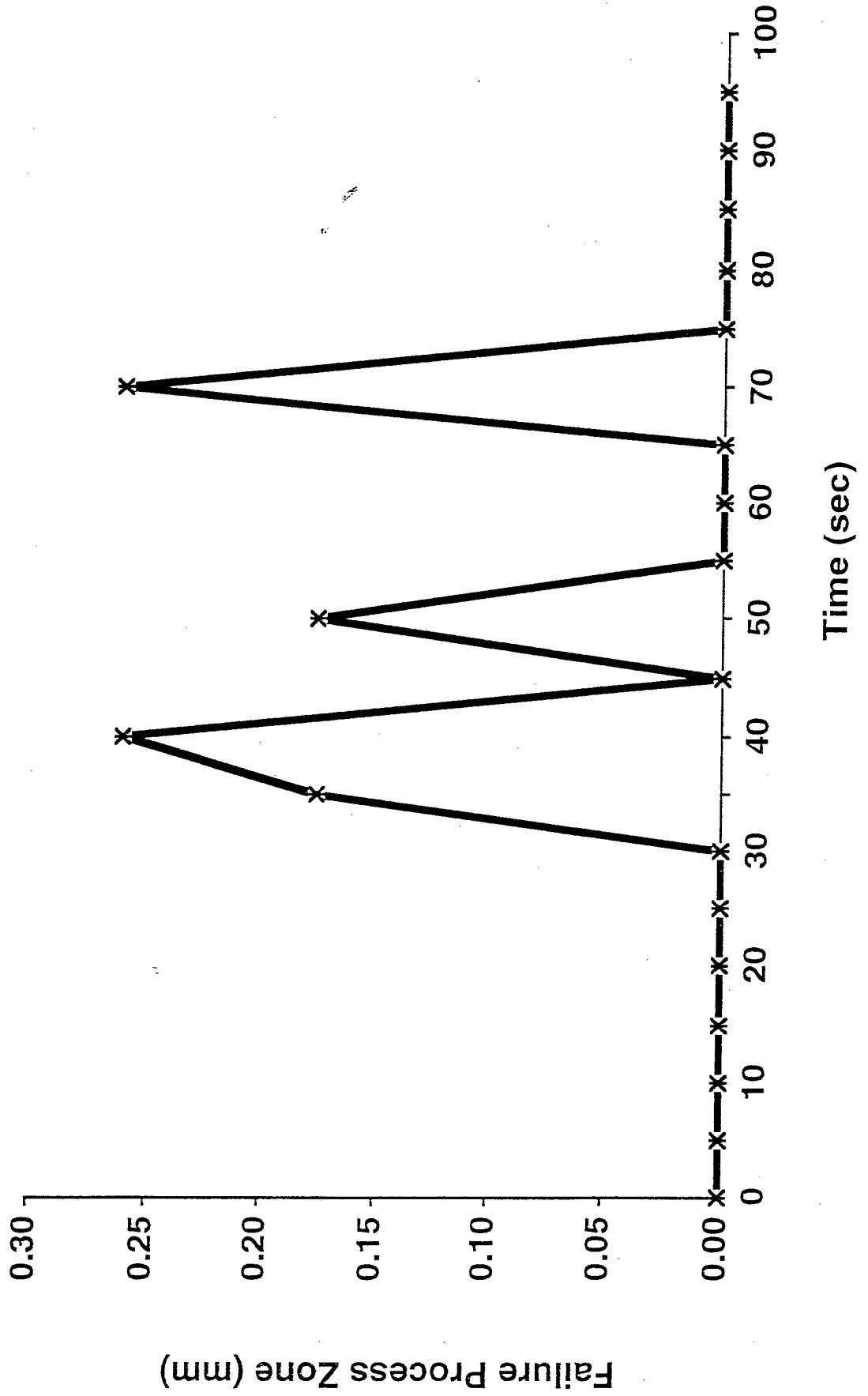


TKLRLT - COD vs. Time





TKLRLT - Failure Process Zone vs. Time



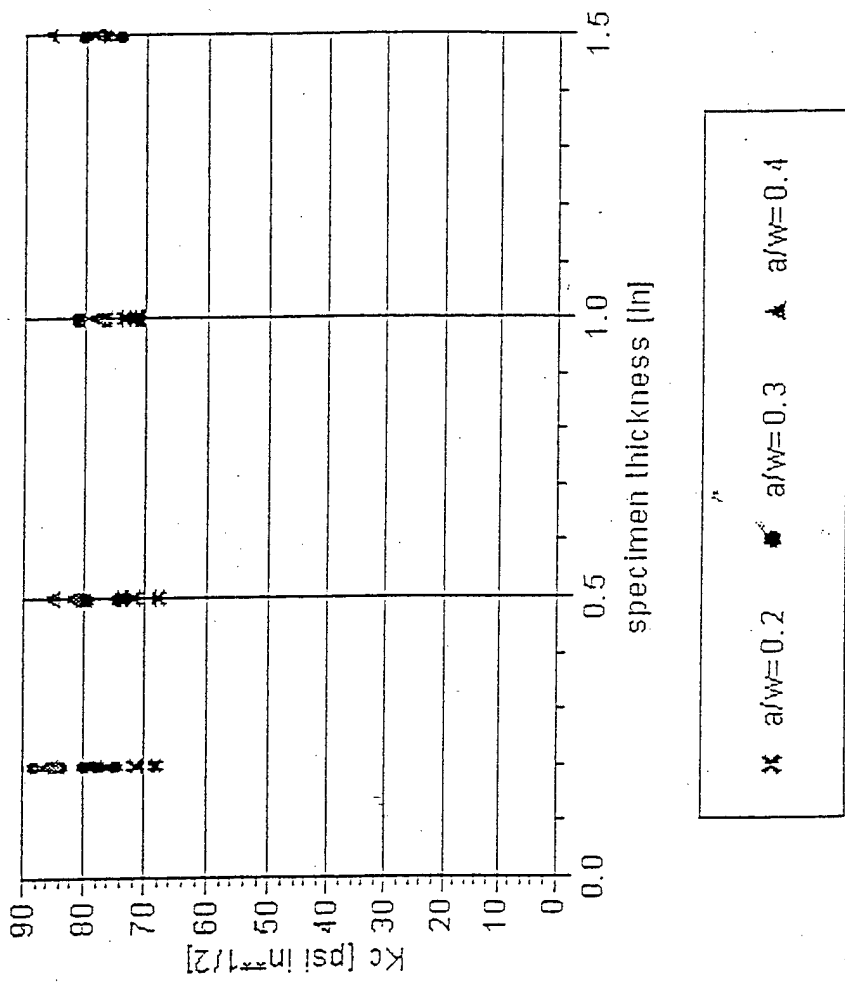


Figure Critical stress intensity factor versus specimen thickness.

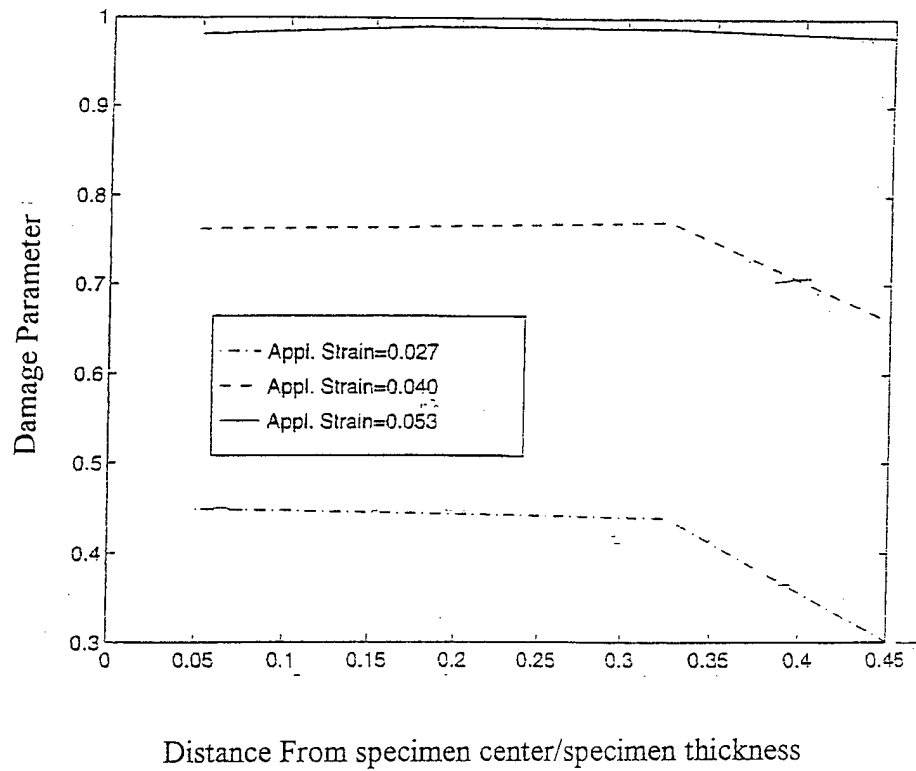


Figure Damage variation along the thickness of the specimen as a function of the applied strain.

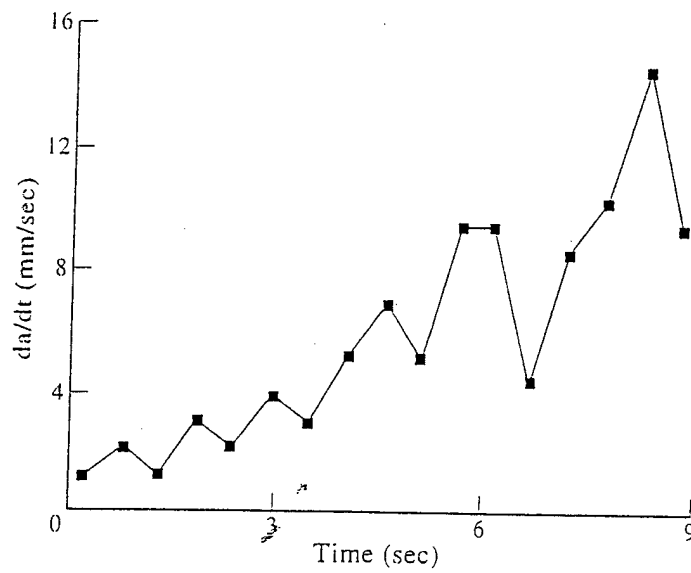


Figure Crack growth rate versus time.



Conclusions



- **Experimental findings reveal that severe damage develops at the crack tip.**
- **The fracture toughness for the onset of crack growth is insensitive to the variation of the thickness of the specimen.**
- **Three-dimensional micro-macro damage analyses reveal that damage distribution is uniform along the crack front, resulting in a straight crack front.**
- **The crack-damage interaction is a contributing factor to the fluctuation of the crack growth behavior.**