ME – M. Tech (Research) Thesis Defense

Numerical simulations of ductile crack initiation in a textured magnesium alloy

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May 04, 2026 at 11:00 AM

Venue: Conference Room, ME@IISc

ABSTRACT

Magnesium alloys have attracted significant interest in the automotive industry due to their low density and potential for improved fuel efficiency. However, their application is limited by low ductility and fracture toughness at room temperature. Void growth and coalescence is one of the primary driving mechanisms of fracture in magnesium alloys. This study investigates ductile crack initiation near a notch-tip by examining the effects of initial void position, void shape, and notch-tip constraint under mixed-mode (I/II) loading conditions in a basal textured Mg alloy.

Crystal plasticity finite element simulations are conducted to study the growth of a circular void, placed directly ahead of the notch tip in a rolled AZ31 Mg alloy under plane strain, mixed-mode, small-scale yielding conditions, and the results are contrasted against a similar void placed at an angle to the notch line. Further, two other important factors affecting near-tip void growth are studied. These pertain to the effects of notch-tip constraint and initial void shape (circular versus elliptical).

It is observed that J at void coalescence stage is lower for the void located ahead of the tip and it diminishes with an increase in mode II component. This is steeper for the elliptical void than the circular one. The loss of notch-tip constraint under mode I retards void growth and enhances J_c . The near-tip void growth trends are rationalized by examining the evolution of triaxility and plastic strains around the void.

ABOUT THE SPEAKER

Vaskar Halder is an M.Tech (research) student in the Dept. of Mechanical Engineering, IISc Bangalore. He obtained his B.Tech degree in Mechanical Engineering from NIT Durgapur in 2023. His research interests are broadly in the mechanical behaviour of engineering materials.