



AN HONORS UNIVERSITY IN MARYLAND

Department of Mechanical Engineering

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## **Advanced High Strength Steels: Their Applications and Challenges**

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**Abstract:** AHSS refer to recently developed automotive steels such as dual phase steels, transformation induced plasticity (TRIP) steels, complex phase steels, martensitic steels. The potential opportunities offered by AHSS in the vehicle weight reduction and crash performance improvements have led to a significantly increased use of advanced high strength steels (AHSS) in the automotive body-in-white components, particularly for those crash sensitive components. Five year ago, no vehicle produced in North America contained any AHSS and today, always every new vehicle coming the markets had some applications of AHSS. In five years, 45% of body-in-white components will be produced using AHSS. To meet the recently introduced regulations and requirements in vehicle side impact and roll-over (roof crush), higher strength AHSS grades with tensile strengths greater than 780 MPa are also used for components such as pillars, roof bows and structural rails and members. Due to high strength nature of AHSS and non-uniform microstructure, several forming related issues have been raised in stamping such as springback, small stretching bending fracture, edge cracking during forming and flanging operations, etc. Some of these forming issues are relatively new to the stamping industry and are often not able to be detected using computer simulations in the product developments and die design stages due to lacking of material failure criteria and/or simulation technologies. In this presentation, the issues associated with springback, stretch bending fracture and edge cracking are discussed. Technical challenges faced in these areas are highlighted and some examples are given. The areas requiring fundamental researches are also outlined.

**Biographical Sketch:** Dr. Shi is currently the manager of advanced applications technology at the automotive center of United States Steel Corporation. His responsibilities include the developments and implementations of automotive steel applications technologies in the areas of sheet metal forming, vehicle structural testing and analyses and crash performance. He is also responsible for the operation of the USS automotive center laboratory, which consists of computer simulations lab, mechanical test lab, material test lab, metallography lab, high bay sample bank, and machine shop. Currently, Dr. Shi leads a group of engineers conducting customer applications R&D projects in areas of springback, forming limits developments, edge cracking and stretch bending fracture, die materials and treatments, bonding technology developments, optimal section geometry designs for crash energy managements, etc. for advanced high strength steels. Prior to joining USS in 1997, Dr. Shi worked at the Product Applications Center of National Steel Corporation conducting R&D projects in the areas of metal forming, dent resistance and tailor welding blank applications. He has authored and co-authored more than 50 papers in areas of sheet metal forming, plasticity, constitutive model developments, springback, dent resistance, crash performance, tailor welded blank applications.

Dr. Shi received his B.S. in Engineering Mechanics from Hohai University and M.S. and Ph.D. in mechanical engineering and engineering mechanics from Michigan Technological University in 1989.

*Refreshments will be served*

Host: Dr. A. Khan