Effects of strain rate and temperature on the properties and behavior of AHSS and austenitic stainless sheet steels

by

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ABSTRACT

Steels are interesting…..although some people think they are just old-fashioned and boring! The fact of the matter is, however, that of the ca. 3,500 different steel grades currently commercially available, 75% have been developed during the past 20 years or so. For example, DP, TRIP and TWIP steels are good representatives of the group of advanced high strength steels (AHSS) that have been developed to meet the special demands put forward by the automotive industry. High strain rates are interesting, too. The reason for this is that the behavior of most materials changes quite markedly when the rate of loading becomes high enough. This is especially true for AHSS steels, whose microstructure is partially metastable and therefore sensitive to both strain rates as such and, in particular, to the changes of material temperature due to the deformation induced (adiabatic) heating at high strain rates at large strains.

In this presentation, current developments of the AHSS sheet steels as well as some austenitic stainless steels are reviewed with emphasis on the deformation and strain hardening mechanisms that give these steels at the same time high strength and high ductility (formability), which are usually contradictory properties for metals and alloys. The most important high strain rate phenomena and testing techniques are also reviewed and discussed. Finally, some recent results of the high strain rate testing of sheet steels with Hopkinson Split Bar technique are presented and discussed.

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Short Bio

Dr. Kuokkala is Professor of Materials Science at the Tampere University of Technology in Tampere, Finland. He obtained his Ph.D. in Materials Science from Tampere University of Technology (TUT) in 1984. Since then, he has held several academic positions at TUT, including Deputy Associate Professor of Materials Science, Deputy Professor of Electron Microscopy, Associate Professor of Materials Science, and Professor of Materials Science since 1998. He has also worked as an Academic Guest at the Eidgenössische Technische Hochschule in Zurich, Switzerland, and as a Long Term Visiting Staff Member at the Center for Materials Science, Los Alamos National Laboratory, New Mexico, USA. His current research interests are the elastic properties and ultrasonic attenuation in solids, computer applications in electron microscopy, and especially the high strain rate behavior of materials. He is currently on sabbatical leave at the Purdue University.