TUESDAY, AUGUST 24, 2004, P.M.

SESSION 34: INTERNATIONAL SYMPOSIUM ON ULTRA-FINE STRUCTURED STEELS

PRODUCT DESIGN AND APPLICATIONS I
Sponsor: Iron and Steel Section, The Metallurgical Society of CIM
Room: Webster C
Chairmen: E. ESSADIQI, J. THOMSON, CANMET, Ottawa, Ontario, Canada, and
M. MILITZER, University of British Columbia, Vancouver, British Columbia, Canada

PAPER 34.1 — 14:00
DEFORMATION BEHAVIOR OF ULTRAFINE STRUCTURE
D. EMBURY, Department of Materials Science and Engineering, McMaster University, Hamilton, Canada
Abstract not available.

PAPER 34.2 — 14:40
SOME VIEWS ON THE STRENGTH AND DUCTILITY OF ULTRA FINE GRAINED STEELS THROUGH MICRO PLASTICITY APPROACH.
M. VENKATRAMAN, Tata Iron and Steel Co, Jamshedpur, India.
The limit of Hall –Petch relationship in ultra fine grained steels has been examined based on dislocation pile-up mechanism. When the grain size becomes small the dislocation multiplicity ceases resulting in very low work hardening rate in these materials. An approximate analysis of the theories of hardening indicates that H-P relation is obeyed up to 100nm. It appears that grain refinement is not the suggested approach to improve toughness as well as strength below a critical size.

COFFEE BREAK — 15:10 – 15:30

PAPER 34.3 — 15:30
MECHANICAL PROPERTIES OF ULTRA-FINE PRECIPITATION HARDENED HOT ROLLED HIGH STRENGTH STEEL.
A. KOBAYASHI, K. SETO, JFE Steel Corp., Kawasaki-ku, Kawasaki, Japan and
Y. FUNAKAWA, JFE Steel Corp., Chuo-ku, Chiba, Japan
A new hot rolled high strength steel consisting of ferrite matrix and nanometer-sized precipitates was developed. The ultra fine precipitates were identified as $TiMoC_2$, and the strengthening by the precipitates was evaluated more than 300MPa in the case of TS/800MPa grade steel. Due to the strengthening effect of the ultra fine precipitates, alloy elements for solid solution hardening can be reduced. It is notable that the steel shows very high yield strength (730MPa in case of TS/800MPa) and very high local elongation leading to excellent stretch flange formability at the same time. The mechanical properties of the steel are attractive for the chassis parts and structural parts of auto body. The steel has been produced commercially, and applied to the parts successfully.

PAPER 34.4 — 16:00
STRAIN-HARDENING DESIGN WITH DISPERSED CEMENTITE FOR LOW CARBON ULTRAFINE-GRAINED STEELS
S. TORIZUKA, K. NAGAI, National Institute for Materials Science, Tsukuba, Ibaraki, Japan and
A. OHMORI, JFE Steel Co., Kurashiki, Okayama, Japan
Strain (work)-hardening in tensile tests was examined for low carbon steels with various ferrite grain sizes ranged from 0.4μm to 16μm. The steels had microstructures composed of ferrite grains and dispersed cementite particles. They were fabricated through warm caliber rolling with an accumulative area reduction of 93%. Strain-hardening rate at a given strain increased with an increase in volume fraction of cementite particles. The balance of yield strength and uniform elongation for ultrafine-grained structures could be improved by the dispersion of cementite particles. Effects of the cementite dispersion and the ferrite grain size on the strain-hardening rate can be roughly explained by the work-hardening model with GN-dislocation density. Strain-hardening design using dispersed cementites was proved to be effective in controlling ductility of the ultrafine-grained steels.

PAPER 34.5 — 16:30

STUDY OF ULTRA-HIGH STRENGTH CRMO STEEL BY USE OF TEM, EDS AND EELS

X. ZHANG, L. ZHANG and J. QI, Key Laboratory of Advanced Magterials, Department of Materials Science and Engineering, Tsinghua University, Beijing, P.R. China

Based on the commercial steel 42CrMo (4140, SCM440), a new generation of CrMo steel was developed by increasing the content of Mo, adding the alloy element of V and Nb, and decreasing the content of P and S. This new CrMo steel has higher strength of 1500MPa and better delayed failure property. TEM and EDS were used to study the distribution and function of the alloying elements in this steel. A new EELS technique were developed to study the bonding strength of the grain boundary in the steel. The mechanism of strengthening of the new steel has been studied.