（＊掲載記事題目及び掲載頁は変更になる場合があります。）

Scanning electrochemical microscopy study of detecting non-homogeneity in surface reactions of metals (Review)

K.Fushimi et al.

Scanning electrochemical microscopy (SECM) is powerful to investigate non-homogeneity of surface reaction in solution. It is useful for evaluating the distribution of electrochemical reactions taking place on the electrode surface such as corrosion reaction, redox reaction on passive film and so on. The heterogeneous electrochemical reaction on polycrystalline iron, titanium and single crystal magnetite electrode surfaces were discussed. SECM can be also employed for inducing locally a certain surface electrochemical reaction on the specimen by operating a probe electrode as liquid-phase ion gun (LPIG). The application of LPIG to the passive film formed on iron for inducing the local film breakdown has revealed the details of its local breakdown process.

(cf. *ISIJ Int.*, **42** (2002), 1325)

Weldability of high nitrogen stainless steel (Review)

I.Woo et al.

The purpose of this paper is to give a short survey of nitrogen influence on stainless steel welds. The review are covers: the levels of nitrogen in weld metal, the influence of nitrogen on stainless steel weld metal characteristics such as weld defects, corrosion resistance and mechanical properties. High nitrogen steel welding must consider the risk of nitrogen escape from the weld pool. Avoiding nitrogen losses may be accomplished by controlling shielding gas, welding parameters and compositions of filler metal. The increase of nitrogen in the weld metal decreases in the δ ferrite content. The reduction of δ ferrite in austenitic weld metals will result in an increase in the solidification cracking susceptibility. However, the role of nitrogen in affecting the solidification cracking susceptibility of fully austenitic weld metals is unclear. Nitrogen addition increases the pitting corrosion resistance in weld metals whereas decreases resistance to stress corrosion cracking because of δ ferrite reduction. Nitrogen also improves mechanical properties in weld metals. However, the presence of nitrides may be detrimental to the mechanical properties in stainless steel welds.

(cf. *ISIJ Int.*, **42** (2002), 1333)

Inclusion formation and microstructure evolution in low alloy steel welds (Review)

S.S.Babu et al.

The paper presents an overview of research performed at Oak Ridge National Laboratory on inclusion-formation, weld-solidification, and solid–state transformations in low-alloy steel welds. The competition between oxide and nitride formation in Fe–C–Al–Mn self-shielded flux-cored arc steel welds was predicted using computational thermodynamics. Nonequilibrium austenite phase selection was monitored in a Fe–C–Al–Mn weld using an *in situ* time-resolved X-ray diffraction technique. The competition between acicular ferrite and bainite formation from austenite was evaluated in Fe–C–Mn steel welds containing small amounts of titanium.

(cf. *ISIJ Int.*, **42** (2002), 1343)

Present status and perspectives of European research in the field of advanced structural steels

G.Buzzichelli et al.

The status of steel research in Europe with particular emphasis to multipartner projects sponsored by the European Community for Steel and Coal (ECSC) is reviewed through specific examples in the field of high strength (HS) designed with various metallurgical options and made possible by different production routes. Modern HS sheets for car body and structural parts of the automotive as well as the new generation of very high strength pipes for high pressure gas lines are discussed in the light of their recent developments inside the European Community R&TD circuit. A rapid glance to HS steel wires for suspension bridges is also given with reference to the newly designed Messina Strait Bridge in Italy.

Some reference to possibilities offered in properties enhancement by the new casting technologies (Thin Slab & Strip Casting) is rapidly commented.

(cf. *ISIJ Int.*, **42** (2002), 1353)

Microstructural degradation of the HAZ in 11Cr–0.4Mo–2W–V–Nb–Cu steel (P122) during creep

N.Komai et al.

The microstructural degradation of the heat affected zone (HAZ) in 11Cr–0.4Mo–2W–V–Nb–Cu steel (P122) during creep was investigated. Creep testing was conducted using two types of specimens at 650°C and 675°C, and ruptured in the fine grained HAZ, known as type IV failure. Weldments were known to be weaker in creep strength than base metal in this test condition. The coarse and fine grained microstructures were observed, and the average grain sizes were measured. The HAZ adjacent to the base metal was characterized by a fine grained microstructure consisting of subgrains with low dislocation density. Hardness of the intercritical area between HAZ and the base metal was the lowest after PWHT and during creep. Creep cavities tended to form at the grain boundaries in the fine grained HAZ due to creep. Small cracks gathered with cavities were observed in the fine grained HAZ after creep, and these corresponded to the fracture portion. $M_{23}C_6$, M_7C_3 and MX type carbides had already precipitated in the HAZ before the creep test. A Laves phase arose at the grain boundary of the coarse and fine grained zones of the HAZ during the test. It is presumed that Laves phase precipitation in the coarse grained HAZ is slower than in the fine grained HAZ and base metal during creep.

(cf. *ISIJ Int.*, **42** (2002), 1363)

Improvement of wear resistance of steels by nitriding using supersonic expanding nitrogen plasma jets

Y.Ando et al.

Plasma jets have been successfully used as heat sources of thermal plasma spraying process. However, since the plasma jet is accelerated to supersonic under a low pressure environment, the plasma jets can be used as low temperature plasmas with high chemical reactivity due to supersonic adiabatic expansion and frozen flow. From this viewpoint, nitriding of titanium plates using supersonic expanding nitrogen plasma jets under a low pressure environment was carried out in our previous study. As a result, it was proved that the plasma jets had enough reactivity to form a hard and thick titanium nitride layer on the surface of a titanium plate by only a few minutes of plasma jet irradiation at 30 Pa chamber pressure. In this study in order to develop a practical low temperature and high rate nitriding process, nitriding of nitriding steel, carbon steel and stainless steel using this process was carried out and wear resistance of these nitrided samples was investigated. Consequently, surface hardening was obviously promoted on the condition that hydrogen/ nitrogen mixture gas were used as working gas in the cases of all substrates. Especially, hard layers with over 1 000 Hv in hardness were formed without any surface damages on the surfaces of the samples by only 5 min of operation in the cases of nitriding steel and stainless steel. Besides, according to the results of wear testing, wear resistance of these steels was dramatically improved.

(cf. *ISIJ Int.*, **42** (2002), 1370)

Prevention of chloride-induced corrosion damage to bridges

S.D.Cramer et al.

The annual direct cost of bridge infrastructure corrosion to the U.S. economy is estimated at $8.3 billion, with indirect costs approximately 10 times higher. Of the approximately 600 000 bridges in the U.S., between 15% and 20% are listed as "structurally deficient", frequently due to corrosion damage. Five technologies are presented for reducing the cost of chloride-induced corrosion damage: (1) conductive coating anodes for cathodic protection of existing reinforce concrete bridges, (2) epoxy-coated rebar (ECR), (3) stainless steel rebar, and (4) high-performance concrete for extending the service life of new structures, and (5) metalizing to provide economical, long-term corrosion protection of steel bridges. Conductive coating anodes and stainless steel rebar represent ongoing work by the Oregon Department of Transportation with final verdicts not expected for years. The ECR and metalizing technology have longer track records and are better established in the bridge construction and protection industry. Application of these technologies is guided by a thorough understanding of their performance, of characteristics of the bridge and its environment, and of the results that are sought.

(cf. *ISIJ Int.*, **42** (2002), 1375)

Effect of argon ion bombardment on diffusion bonding of SUS304L stainless steel and pure iron

A.Wang et al.

The surfaces of SUS304L stainless steel and pure iron specimens prepared by a lapping method were treated with argon ion bombardment, and then diffusion bonding was carried out. The effect of argon ion bombardment treatment on the properties of diffusion bonding joint was investigated by the tensile