XPS Determination of Compositions of Alloy Surfaces and Surface Oxides on Mechanically Polished Iron-Chromium Alloys(Metallurgy)

Metallurgy

Pretransition Phenomena

H.E. Cook, M. Suezawa, T. Kajitani and L. Rivaud
J. Phys. (Paris), Colloq. (1977), C7, 430.

Four types of fluctuations — 1) classical, 2) antiphase, 3) heterophase and 4) critical — are described and used to review several broad aspects of pretransition phenomena that have been reported near second- and first-order transitions in both real and model systems. Direct observations of pretransition phenomena in the electron microscope have revealed critical fluctuations in an Fe–26.5 a/o Al alloy and heterophase fluctuations in a CuAu alloy. The latter appear to be interacting strongly with dislocations and the free surface of the foil. Evidence for heterophase fluctuations in Cu_3Au has also recently been reported based on the temperature dependence of the short range order intensity near the transformation temperature. Experiments on the central peaks observed at structural phase transitions suggest that they have a dual intrinsic-extrinsic origin resulting from a mix of dynamical cluster waves and static clusters formed at impurities and defects. Computer experiments on model systems are reviewed as they give an insight into phase transitions and allow an exacting test of theoretical formulations without the many complicating effects found in real systems.

The X-Ray Photo-Electron Spectra of Several Oxides of Iron and Chromium

K. Asami and K. Hashimoto
Corros. Sci., **17** (1977), 559.

X-ray photo-electron spectra of Fe_2O_3, Fe_3O_4, α-FeOOH, γ-FeOOH, Cr_2O_3, $Cr(OH)_3 \cdot 0.4H_2O$ and CrO_3 were measured. The peak binding energies of $2p$, $3s$ and $3p$ electrons of Fe and Cr in the above substances were determined. The largest valency dependence was observed in $2p$ electrons. Binding energies of O $1s$ electrons were also measured for those oxides and hydroxides. For quantitative analysis the ratios of photo-electron cross-sections of Fe $2p_{3/2}$ and Cr $2p_{3/2}$ to O $1s$ electron levels were estimated as 1.45 and 1.71, respectively, for excitation by Al $K\alpha_{1,2}$ radiation.

XPS Determination of Compositions of Alloy Surfaces and Surface Oxides on Mechanically Polished Iron-Chromium Alloys

K. Asami, K. Hashimoto and S. Shimodaira
Corros. Sci., **17** (1977), 713.

Using the XPS technique, the compositions of the alloy surface and the surface oxide on mechanically polished iron-chromium alloys were studied. For quantitative analysis, the ratio of photo-ionization cross section of Fe $2p_{3/2}$ electrons to that of Cr $2p_{3/2}$ electrons was estimated as 1.35 for Al $K\alpha_{1,2}$ radiation. Assuming a

homogeneous oxide layer, the thickness of the oxide layer and compositions of the alloy surface and the surface oxide were simultaneously determined. The results showed no enrichment of chromium or iron either in the oxide layer or the alloy surface. Results on binding energies were also given.

Effect of Electrochemical Potential on Stress-Corrosion Morphology of Type 304L Stainless Steel in H_2SO_4/NaCl Solutions at Room Temperature

Michinori TAKANO and Roger W. STAEHLE

Trans. Jap. Inst. Met., **18** (1977), 780.

The stress corrosion behavior of AISI Type 304L stainless steel has been investigated in H_2SO_4/NaCl solutions using potentiostatically controlled and dynamically loaded wire specimens at room temperature.

In this study the morphology of attack was varied with potentials such as corrosion potential, active/passive and passive/transpassive transition potentials. The morphologies observed included transgranular stress corrosion cracking, intergranular attack, pitting and general corrosion. The most extensive transgranular cracking was observed near the corrosion potential in 5 mol/l H_2SO_4/0.1 mol/l NaCl solution. In the other solutions transgranular cracking was also observed, but cracks were very shallow and failure was a ductile one.

Stress corrosion morphology in acid aqueous solution containing Cl^- ions was very complicated, depending upon a controlled potential and concentration of acid and/or chloride. Stress corrosion cracking proceeded under the condition where the surface film was stable and only slip steps were chemically active.

The existence of various morphologies was consistent with the film break/reformation concept of stress corrosion cracking.

The Mechanism of Intergranular Stress-Corrosion Cracking in Cu-30%Zn Alloy and 304 Stainless Steel

Michinori TAKANO

Trans. Jap. Inst. Met., **18** (1977), 787.

Stress-corrosion cracking (SCC) of commercial Cu-30%Zn alloy in Mattsson's solution and an aqueous ammoniacal solution at room temperature, and of 304 stainless steel in 128°C boiling $MgCl_2$ aqueous solution has been investigated by determining the crack propagation rate ($\dot{\gamma}$) as a function of the strain rate ($\dot{\varepsilon}$), and by observing the fracture surfaces.

For a transgranular cracking environment, $\dot{\gamma}$-$\dot{\varepsilon}$ curves showed region I where $\dot{\gamma}$ increased with increasing $\dot{\varepsilon}$ at slow strain rates and region II where $\dot{\gamma}$ was independent of $\dot{\varepsilon}$ at high strain rates. For an intergranular cracking environment, the curves showed region I at slow strain rates and region II' where $\dot{\gamma}$ decreased with increasing $\dot{\varepsilon}$ at high strain rates.

The region of strain rates where intergranular SCC occurred was narrower than that for transgranular SCC.