グローバルCOE物質科学イノベーション講演会

演 題：Grain Dependent Dissolution and Passivation of Iron

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場 所：工学部材料・化学系棟大会議室（MC526室）

要 旨：
Technical metals and alloys are used in a polycrystalline state. Accordingly, they show surfaces structured by grains and grain boundaries and electrochemical processes such as passivation and corrosion become non-homogeneous reactions. Therefore, knowledge of the influence of the orientation of different grains on these processes is necessary for fundamental understanding. Such investigations were carried out on Al, Ta, Hf, Zr and Fe. Most data are available for polycrystalline ARMCO iron, where we investigated etching rates, anodic dissolution up to extremely large current densities, high field passivation and oxygen evolution of randomly oriented grains. The use of single crystals is also possible but expensive, requires time consuming preparation and is limited to a small number of specimens and, thus, few orientations.
The samples were first examined by AFM, and then individual grains were addressed by an especially developed capillary micro cell. From cyclovoltammogramms and capacity measurements the charges of oxide formation and oxygen evolution were determined as well as the dielectric properties of the surface film. In a third step the crystallographic orientation of the investigated grain was determined by **E**lectron **B**ack**S**catter **D**iffraction (EBSD). Finally, the thicknesses of the oxide films of selected grains were measured by micro ellipsommetry. Altogether, we yielded data of dissolution rates, oxide formation rates and thicknesses, oxygen evolution, all as functions of the corresponding *Euler* angles of the iron grains. These data correlate only in some cases with the density of iron surface atoms. Therefore an alternative concept for understanding had to be found.
Quantum mechanical calculations by solving the Schrödinger Equation for all electrons of more than hundred atoms yielded interesting data to explain the different properties of the oriented iron surfaces. These data fit well to those from the experiments.

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演 題：Reactivity Imaging of a Passive Ferritic FeAlCr Steel

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日 時：2008年7月28日（月）16:00 ～

場 所：工学部材料・化学系棟大会議室（MC526室）

要 旨：
A technique named reactivity imaging is introduced. It combines optical imaging of a polycrystalline material with orientation imaging by electron back scattering diffraction (EBSD) for a determination of the crystallographic orientation map and scanning electrochemical microscopy (SECM) for a visualization of the local reactivity. Dissolving metal ions from the substrate are directly detected by the scanning Pt tip of the SECM to measure the amount of locally dissolving material. A ferritic light weight steel (alloy Fe7.5Al7Cr) with a strong anisotropic dissolution behaviour was investigated as an example. This steel shows good passivation behaviour both, in air and through anodisation. In the passive state investigated here, the difference in dissolution rate between various crystallographic orientations is only marginal. Grain boundaries on the other hand showed a higher activity as compared to the grains themselves, which is attributed to the electronic tunneling in the grain boundaries. The results demonstrate that the rate determining step responsible for the anisotropic dissolution does not result from a deficiency in passivation but from the active dissolution kinetics.