1. EELS and Ab-Initio Study of Faceted CSL Boundary in Silicon

   N. Sakaguchi, M. Miyake, S. Watanabe, H. Takahashi

   Materials Transaction, 2010, 1-4, Advance View

   Faceted Σ3 CSL grain boundaries in silicon were investigated by high-resolution transmission electron microscopy (HRTEM), electron energy-loss spectroscopy (EELS) and *ab-initio* calculation. A {112} Σ 3 CSL boundary consisted of two segments which differed in atomic structure. The segment near the connected corner to {111} Σ 3 CSL boundary showed symmetric structure and the other long segment, being distant region from the corner, showed asymmetric structure. In the symmetric segment a 5-fold coordinated atom presented, which produced a deep state in the band gap. A pronounced shoulder, which could be attributed to the defect state above Fermi level, was detected only in Si-L_{23} energy-loss near-edge spectra (ELNES) acquired from the symmetric segment of the {112} Σ 3 CSL boundary near the CSL junction.

2. Effect of hydrogen ion/electron dual-beam irradiation on microstructural damage of a 12Cr-ODS ferrite steel

   Yang Zhanbing, Hu Benfu, H. Kinoshita, H. Takahashi, S. Watanabe

   Journal of Nuclear Materials, 398 (2010) 81–86

   The effect of hydrogen ion/electron dual-beam irradiation on the microstructural evolution of a new 12Cr-ODS ferrite steel made by chemical soaking method (CSM) was investigated. The results showed that the dislocations were introduced at the initial stage of irradiation and then developed into dislocation networks. The void swellings after the irradiation to a dose of 15 dpa were less than 0.15%. The interface between the dispersed oxide particle and the matrix became irregular due to the irradiation; while the macroscopic size change of the oxide particle was not recognized, thus suggesting that the steel had a good resistance to irradiation during the dual-beam irradiations between 623 K and 823 K. The formation of voids with small mean size and high number density was closely concerned with hydrogen which would assist the void nucleation as a result of hydrogen ion trapping vacancies during the irradiation.

3. Transmission electron microscopic observation of cells cultured on multiwalled carbon nanotube-coated sponges

   E. Hirata, N. Sakaguchi, M. Uo, N. Ushijima, Y. Nodasaka, F. Watari, H. Ichinose, A. Yokoyama

   Journal of Electron Microscopy, 59 (2010) 447–450

   The cell structure and interface between cultured cells and a multiwalled carbon nanotube

(MWCNT)-coated sponge (MWCNT-coated sponge) were observed by transmission electron microscopy (TEM). Moreover, the atomic structure of MWCNTs that entered the cells was also examined by means of high-resolution TEM (HRTEM). MWCNTs were observed in the cytoplasm, and a few MWCNTs were recognized in the cell nuclei. Those MWCNTs maintained their structure there. Subcellular organelles did not appear to be different from those on the collagen sponge despite the cellular uptake of MWCNTs.

4. Phase Transformation and Capacitance Enhancement of Anodic ZrO_2–SiO_2

S. Koyama, Y. Aoki, N. Sakaguchi, S. Nagata, H. Habazaki

Journal of The Electrochemical Society, 157 (2010) C444-C451

Capacitance enhancement of anodic oxide films on zirconium by adding silicon is reported here with correlation to the phase transformation of the oxide. The anodic oxide film formed on zirconium consists mainly of monoclinic ZrO_2, which changes to tetragonal ZrO_2 phase on the Zr–5.5 atom % Si. Further increase in the silicon contents to 10 and 16 atom % results in the formation of amorphous oxide up to 30 V, above which two-layered films, comprising an outer crystalline tetragonal-phase oxide layer and an inner amorphous layer, are developed. The relative thickness of the outer crystalline layer to the total film thickness increases with formation voltage. The highest capacitance of the anodic oxide films is obtained on the Zr–10 atom % Si. The changes in capacitance, permittivity and formation ratio of anodic oxide films with alloy composition are discussed with phase transformation and growth process of anodic oxides.

5. *In situ* observation of self-organizing nanodot formation under nanosecond-pulsed laser irradiation on Si surface

S. Watanabe, Y. Yoshida, S. Kayashima, S. Yatsu, M. Kawai, and T. Kato

JOURNAL OF APPLIED PHYSICS 108, 103510 2010

An *in situ* observation of the formation of a laser-irradiation-induced nanodot array on a Si surface was performed using a pulsed-laser-equipped high-voltage electron microscope laser-HVEM. Under multiple nanosecond _ns_ pulsed laser irradiation shots, atomic clusters were first formed and distributed on the surface in order to grow them epitaxially into protruded dots with diameters of ten nanometers or less. This is followed by their diffusion induced by successive laser shots to cannibalize and merge them into a ripple line with aligned, larger dots. We conclude that the present subwavelength two-dimensionally-ordered nanodot array is formed by self-organization under pulsed laser irradiation.

6. In-situ Observation of Fracture Behavior on Nano Structure in NITE SiC/SiC Composite by HVEM

Tamaki Shibayama, Genichiro Matsuo, Kouichi Hamada, Seiichi Watanabe and Hirotatsu Kishimoto

Materials Science and Engineering, ICC3, IOP, 2010, in press.

We have been successfully done in situ observation on the sequence of fracture event at the interface of NITE SiC/SiC composite examined by using miniaturized double notched shear specimen for TEM prepared by Focused Ion Beam method. In this study, we used nano-mechanics TEM experimental apparatus to investigate not only microstructure evolution and but also load and displacement curve at once in High Voltage Electron Microscope. Our results summarize as follows. Cracks were initiated at the interface between carbon coating layer on the SiC fiber and SiC matrices, and propagated along the interface. Load drop in the load and displacement curve during in-situ TEM was clearly observed at the crack initiation. The shear strength by using the miniaturized specimen is about ten times higher than that obtained by the standard testing.