MS46 P01

Reconstruction of High-Temperature Deformation Processes in Zr-based Alloys Perlovich Yu.[a], Isaenkova M.[a], Krymskaya O.[a], Kropachev S.[b], Akhtonov S.[b] [a]*Moscow Engineering Physics Institute, Moscow,Russia.* [b] *Chepetckiy Mechanical Plant, Glazov, Russia.*
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Keywords: Zr-based alloys-1, high-temperature deformation-2, phase transformation-3.

Processes of high-temperature deformation are reconstructed as applied to commercial Zr-Nb alloys by features of diffraction lines, measured at room temperature. These alloys are characterized by phase transformations α↔β within a temperature interval 610^{o} - 860^{o}C, where the high-temperature β-phase and the low-temperature α-phase have crystalline lattices BCC and HCP, respectively. Forging at temperatures of β- and (α+β)-regions of the phase diagram are favorable for operation of various deformation mechanisms, among which there are crystallographic slip in α- and β-phases as well as mutual displacements of crystallites along interphase boundaries under phase transformation or along intergranular boundaries under dynamic recrystallization. Experimental study was conducted as applied to model samples and real billets from Zr-based alloys, subjected to forging by various temperature-rate regimes [1]. In order to reveal the concrete mechanisms, operating by different deformation regimes, changes of X-ray line profiles and the texture by passing from one regime to another were considered. It was ascertained, how sensitive are main parameters of X-ray lines relative to different substructure features.

Deformation at temperatures of (α+β)-region is inevitably associated with α→β phase transformation due to additional local heating near shear bands. Besides, deformation at the phase transformation temperature additionally reduces stability of the crystalline lattice, so that repeated cyclic phase transformations prove to be possible. Activation of the phase-boundary slippage, resulting in texture scattering, is most probable by equal contents of both phases. As the deformation temperature increases, a volume fraction of β-grains and their size grow, the phase-boundary slippage weakens and the intragranular crystallographic slip intensifies. Structure features of alloys at high temperatures determine the operating deformation mechanisms as well as the character of quenching effects, which control the physical broadening of X-ray lines, measured for α-matrix at room temperature.

Parameters of α-Zr crystalline lattice vary depending on the content of dissolved Nb and other alloying elements, on the dislocation density and, most of all, on the residual strain. The content of α-phase in the alloy at the deformation temperature decreases with growth of this temperature, and a volume reduction of the deformed sample due to β→α phase transformation by the following quenching becomes more uniform as the temperature of previous deformation increases. The phase transformation α→β develops with a volumetric expansion, and at high temperatures stresses due to interaction between residual α-grains and new-originated β-grains are relaxing. Therefore, when grains of modified α-phase, experienced α→β→α phase transformations, return by cooling to the initial volume, their crystalline lattice proves to be extended. This elastic strain depends on the deformation temperature, i.e. on the fraction of α-grains, participated in phase transformations, and on the development of deformation-induced phase transformations.

[1] Isaenkova M., Perlovich Yu., Fesenko V. et al. *Mater. Sci. Forum*, 2007, 550, 637.

MS46 P02

X-ray induced structural changes in organic and biological crystalline materials. F. Camus[a], C. Besnard[a], A. Dahlström[a], I. Margiolaki[b], P. Pattison[a,c], M. Schiltz[a], [a]*Laboratory of Crystallography, EPFL, Lausanne, Switzerland.* [c]*ID31, ESRF, Grenoble, France.* [c]*SNBL, ESRF, Grenoble, France.* E-mail: fabrice.camus@epfl.ch

Keywords: synchrotron powder diffraction, radiation chemistry, radiation damage studies

The investigation of radiation-induced processes in organic and biological molecules is of importance for gaining a better understanding of the fundamental mechanisms by which certain compounds (*e.g.* halogenated nucleotides) induce a radio-sensitizing action and can thus be used to improve anticancer radiotherapies since they allow to selectively enhance the therapeutic effectiveness of ionizing radiation by increasing tumor-cell killing and minimizing normal-tissue toxicity. Molecular damage to the DNA molecule induced by ionizing radiation in living organisms plays also a critical role in the development of tumors and substantial research efforts are underway in this field but relatively little is known about the chain of molecular and structural processes that leads from the initial radiation event to a DNA strand break. . Our project focuses on the component molecules of DNA – nucleobases and nucleosides.

We have carried out powder diffraction measurements to investigate structural changes as a function of X-ray irradiation in organic and biological crystals. In these experiments, synchrotron radiation is used to both irradiate the samples and collect diffraction data. Powder diffraction is employed to monitor changes in the unit cell and micro-structural parameters (crystallite size and lattice strain) in crystals of native and halogenated nucleobases and nucleosides under X-ray irradiation. Our aim in these studies is to investigate radiation-induced changes as a function of temperature, wavelength and X-ray dose rate. Attempts to interpret the observed unit-cell expansions in terms of radiation-induced structural modifications in the crystal will be discussed.

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X-ray Powder Diffraction Analysis of Sigma-Phase in Welded Fe-Cr-Ni Alloys Jorge L. Garin, Rodolfo L. Mannheim, *Department of Metallurgical Engineering, Universidad de Santiago de Chile, Santiago, Chile.*
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Keywords: x-ray diffraction, sigma phase, Fe-Cr-Ni alloys

Commercial Fe-Cr-Ni alloys such as cast heat-resistant steels are an important class of elevated-temperature materials currently being considered for welding applications in the metallurgical and mining industry; however, the metallurgical characterization of fusion welds of these materials in service at elevated temperatures, has shown the precipitation of intermediate