complex phases, where sigma-phase is the most significant compound in the microstructure, due to its detrimental influence on the mechanical properties of the alloy. This phase is a complex intermetallic compound of Fe and Cr, based upon an ideal stoichiometric composition AX_2, Pearson's code tP30 and space group P_2/mnm.
Owing to the usually complex diffraction patterns, which disclose many overlapping reflections, and the strong textures caused by the welding process, the Rietveld method was used to resolve those difficulties in to representative welded joints, such as HC-type (25Cr-3Ni) and HD-type (30Cr-6Ni). The Rietveld refinements were performed based upon typical measurement and global parameters. The powder diffraction patterns of the weldments resulted in strong preferred orientation effects due to the uniaxial solidification of the weld metal-pool, which was corrected in the Rietveld refinement by using the March-Dollase function. The pseudo-Voigt function was used for the simulation of the peak shapes, while the background was modeled by a 3rd order polynomial in 2θ with refinable coefficients. A total of five phases, namely ferrite (Cr,Ni), austenite (Ni,Cr), sigma phase, $Cr_{23}C_6$ and Cr_7C_3 were identified and considered in the quantitative analysis. The results obtained revealed that a quantitative microstructural characterization of the weld in heat resistant steels is properly achieved by Rietveld processing of the x-ray diffraction data.

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Characterization of elastic properties of nanostructured thin films by X-rays

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Keywords: X-ray diffraction, strain determination, thin films

Understanding the mechanical behaviour of nanostructured thin films in relation with their microstructure is of high importance for the development of technological applications. The present approach to the problem consists to prepare thin films with controlled microstructure, then to characterize the mechanical response of these films thanks to the development of diffraction based techniques, and finally to analyse experimental results using mechanical modelling of elastic grain interaction. Our research was mainly oriented on the investigation of the elastic properties of single phase thin films (W or Au) [1, 2]. We have shown the feasibility of such experimental techniques and verified that the mechanical behaviour is related to the gold thin film microstructure, i.e. the texture [3]. We are now focussing our research on nanometric multilayer such as W/Au and W/Cu systems elaborated by ion beam sputtering techniques in order to study the mechanical behaviour for different period thicknesses. These metallic multilayers are supported by a (thin) polyimide substrate. Multilayer mechanical response of the two diffracting phases is characterized experimentally through in situ tensile testing in diffractometers available at our laboratory and at synchrotron beamlines. Results are interpreted by an appropriated mechanical modelling accounting for the material microstructure, based on homogenization schemes [4].

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MS46 P05

Microstructure of Metals after Severe Plastic Deformation Studied by Different Methods.

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Severe plastic deformation is an effective tool for production of compact sub-microcrystalline materials of high purity and no residual porosity. In principle, there are two basic techniques – equal channel angular pressing (ECAP) and high-pressure torsion (HPT). In present work, samples prepared by both techniques were studied. Copper and copper composites with different amounts of Al_2O_3 and Zr were selected for studies by different techniques - X-ray powder diffraction (PXRD), transmission electron microscopy (TEM), positron life-time spectroscopy and electron back-scattered diffraction (EBSD). Conventional powder diffraction was performed with the aid of Seifert-FPM diffractometer XRD7 and with Panalytical X'Pert Pro. The evaluation consisted mainly in the line profile analysis for the estimation of dislocation density and crystallite size. Pole figures were measured with Panalytical MRD equipped with the Eulerian cradle and polycapillary in the primary beam.
Line broadening analysis showed that the HPT samples (6 GPa, 7 rotations) have smaller crystallite size compare to the ECAP samples in the range 100 – 300 nm, the dislocation densities are similar – of the order of $1\times10^{15}m^{-2}$. In samples with Al_2O_3 smaller crystallites below 100 nm were found. There are only small changes in the mean dislocation density with the increasing number of passes for ECAP. This fact is well confirmed also by positron annihilation. TEM pictures discovered that after the first pass, the dislocation cells strongly elongated along {111} planes and with low-angle boundaries appeared. After the second pass the grain size is slightly reduced and after the fourth pass, the fraction of equiaxed subgrains increased and the larger proportion of high angle grain boundaries was observed. After eight passes almost homogeneous microstructure with equiaxed subgrains separated by mostly high-angle grain boundaries was observed.
Pole figures obtained from HPT samples indicate fiber texture (often mixed (111)-(100)). ECAP samples have quite complicated textures that are changing with number and type of passes. The measurements were performed in the plane transversal to the direction of pressing. The dominant component is (111) slightly inclined to the surface. With increasing number of passes more components appear and they are broader. After 8 passes, the (110) component is the strongest one. It seems that in