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A: Advanced Materials & Processes

A-1 Evolution of microstructure and texture in AA1100 during multi-axial diagonal forging

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A-2 Development of micro fibril textures in melt-spun polyamide-6 fibers by transversal compression

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A-3 Microstructure and Texture of Titanium grade 2 after ECAP Processing

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A-4 Texture, microstructure and mechanical properties evolution in Fe-(x=36 and 48 wt.%) Ni alloy after accumulative roll bonding

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A-5 Characterization of Fe-Co soft ferromagnetic alloys processed by laser engineered net shaping (LENS)

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A-6 directionally solidified non-modulated Ni₅₄Mn₂₄Ga₂₂ alloys in a gradient magnetic field

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B: Grain Boundaries

B-1 Obtaining 5D Grain Boundary Character from Surface EBSD using Band Intensity Profiles

[A. Amalaraj](#), J. Christensen, O.K. Johnson, E.R. Homer, D.T. Fullwood Brigham Young University, Provo, USA.

B-2 Effect of grain boundary engineering on the corrosion behavior of Hastelloy C-276

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B-3 Microcrack Initiation and its Propagation in Cu metal films on a flexible PI substrate during cyclic-bend testing

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C: Characterization

C-1 Texture Analysis using High Energy Material Science Beam Line (HEMS)@Petra III/HASYLAB-Hamburg

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C-2 Comparison of preferred orientation of austenite and ferrite phases of duplex steel with rolled single phase austenitic and ferritic steel

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C-3 Quantitative Fiber Diffraction: from polymers to composites

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C-4 Practical applications of nondestructive texture measurement methods

[M. Seps](#), M. Benke and V. Mertinger University of Miskolc, Miskolc, Hungary.

C-5 Rotation angle optimization for texture measurement using TOF neutron diffraction

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Pole figure measurement methods for centerless X-ray diffractometers

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The present paper introduces new texture measurement methods developed for mobile/fixed centerless X-ray diffractometers. Using these methods pole figures can be obtained with all the benefits of centerless diffractometers: no need for sample cutting, flexibility in case of large components with complex shapes, short measuring time and portability. The paper describes the measurement methods, includes the validations with conventional pole figure measurements and provides instances of applications of the new technique.

Quantification of local anisotropy and microstructure-property relationships using canonical correlation analysis

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Microstructure-property relationships in two-phase titanium alloys have generally been evaluated qualitatively and are based on their macroscopic behavior. However, structural and texture changes at the microscopic scale can result in failure of a material much before the macroscopic predictions. With the advent of powerful computers and advanced data-driven techniques, the relationship between local anisotropy, microstructural features and mechanical properties can be efficiently quantified for a statistically large volume of the material.

Canonical correlation analysis (CCA) has been used to understand the effect of microtexture and microstructural features on the deformation behavior and texture evolution during uniaxial compression for Ti-6Al-4V. CCA is a multivariate approach that can reveal the global sensitivities of individual variables in a model or a phenomenon. CCA is preferred over other commonly used sensitivity techniques because it provides a measure of both the relative contribution of the variable and its interrelationships with other variables. The microstructural and texture features analyzed in this study include particle size, particle shape, grain orientation, intragranular misorientation and grain boundary characteristics. An elastoviscoplastic fast Fourier transform (FFT) simulation is used to predict the local stress and strain rate behavior based on representative 3D microstructures.

The predictions from CCA are compared with expected material behavior based on physical explanations and experimental observations. Quantifying local microstructure-property relationships will aid in the identification of local sites more prone to failure and the factors most likely to cause them. A better understanding of these relationships will eventually allow greater control over the performance of the material under extreme conditions.

Geometric distortion corrections of EBSD Scans

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Some types of materials require EBSD mapping from large areas to get representative results because grain sizes are in the order of several mms and statistically significant crystal preferred orientations require several hundred or thousands of individual grain measurements. Typical examples are large silicon wafers, geological thin sections, welding, etc. EBSD maps are acquired in x- and y-directions with a certain overlap and in the end stitched together to get a large area EBSD map. The larger the individual square maps the faster the total acquisition will be as there will be less stage moves and less recombination of areas. However, and especially at low magnification, the scanned area will be distorted due to the high EBSD tilt angle, typically 70° and this scanned area will have a trapezoidal distortion if no shape correction is applied. The distortion will increase with decreasing magnification. As a consequence, stitching such areas with trapezoidal distortion leads to mismatch between neighbor areas. To correct for this distortion a theoretical or an experimental calibration method could be applied. In the present case a calibration method has been developed to correct for the distortion. A calibration specimen with square grids has been used for the calibration procedure. The calibration specimen was tilted and the SEM parameters (magnification, tilt angle, high voltage, working distance) were set to the same experimental values as for the real EBSD scan (done after the calibration procedure). The EBSD detector should be in the in-position during calibration. The calibration procedure is carried out by marking 4 points on the distorted square grid. These 4 points must be the corners on a square grid and the points should be close to the 4 corners of the tilt corrected and dynamically corrected electron image. The stage moves are applied either moving only x and y in the case of a eucentric stage with a stage 70° tilted or moving x, y and z if a pre-tilted specimen holder is used. In addition of this procedure, automatically acquired, indexed and reconstructed multi-area maps will be presented.

The only filtered radiation, used in this experimental setup, represented an additional problem as relatively strong spots are visible in the diffraction images due to the sharp texture and residual Bremsstrahlung. The adoption of the Ebel tube description [3] is sufficient for the modeling of these extra spots and to solve elegantly the problem. This opens the question if it would be more efficient to use non monochromatic radiation, as in a true Laue camera, to analyze this kind of sharp textures, that make fibers closer to single crystals than to polycrystalline materials.

- [1] L. Lutterotti, M. Bortolotti, G. Ischia, I. Lonardelli and H. -R. Wenk (1997) *Z. Kristallogr. Suppl.* **26**, 125.
- [2] L. Lutterotti, M. Voltolini, H. -R. Wenk, K. Bandyopadhyay and T. Vanorio (2010) *Am. Mineralogist* **95**, 98.
- [3] H. Ebel (1999) *X-ray Spectrometry* **28**, 255.

C-4 Practical applications of nondestructive texture measurement methods

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The present poster introduces practical applications of new, sample cutting-free texture measurement methods developed for centerless X-ray diffractometers. The possibilities offered by the techniques are shown through practical implementations of the methods from the field of metal forming, mineralogy and archaeometry using a certain type of centerless X-ray diffractometer. The execution of the measurements and the required minor hardware modifications are also presented.

C-5 Rotation angle optimization for texture measurement using TOF neutron diffraction

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Bulk texture measurements using pulsed neutron diffraction is a routine application of the HIPPO (High-Pressure-Preferred Orientation) instrument at LANSCE (Los Alamos Neutron Science Center), but is also available at GEM/ISIS, iMATERIA/J-PARG or NOMAD/SNS. Each of these instruments makes use of a vast detector coverage and typically several rotations are employed to maximize this coverage. However, to the best of our knowledge, a tool to optimize the measurement angles to maximize the pole figure coverage is not available. Here, we describe an approach employing the *General Mapping Tool (GMT)* and *ImageJ* to quantify the coverage achieved by a given combination of measurements and rotation angles. Our approach consists of the following steps:

- Measure the detector panels' positions in the real space and project them on a two-dimensional plane in an equal area projection.
- Rotate the projected image by given rotation angles.
- Superimpose all of the rotated images on the initial one and calculate the area fraction of detector panels.

With this approach, we find that for HIPPO with 45 detector panels around the diffraction center, covering 40°, 60°, 90°, 120° and 144° nominal diffraction angles, the pole figure coverage is about 35%. Through the aforementioned procedure it was clarified that the

coverage for the current standard angle set (0°, 67.5°, 90°) is 67.8%. The coverage could be increased to 71.5% by adopting the optimized angle set (0°, 55°, 215°). The method is applicable to any instrument for which detector coordinates are available.

C-6 ANDES: a multi-purpose neutron diffractometer for the RA10

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The Argentinean Atomic Energy Commission (CNEA) is building a multi-purpose research reactor in Centro Atómico Ezeiza, 30 km from Buenos Aires Argentina, with commissioning planned for mid 2020. The RA-10 will be an open-pool facility for radioisotope production, materials and fuel irradiation, silicon doping and neutron techniques applications. Associated to this last goal there is a separate project to build the Argentinean Neutron Beams Laboratory (LAHN), also executed by CNEA and funded by the National Government. The first stage of LAHN project includes two instruments of particular application in (nuclear) materials research and development. One of them is ANDES (Advanced Neutron Diffractometer for Engineering and Science), a multi-purpose neutron diffractometer for materials science and engineering applications, able to perform a variety of analysis, both on intact objects and on small samples. The techniques available include strain scanning, texture measurement, and high intensity powder diffraction on a variety of environments. The development of this instrument is supported in 4 main areas: shielding design, mechanical engineering design, neutron optics and automation and control. In this work we present the advances in the conceptual design of the instrument.

C-7 Progress on the Development of Texture Analysis Capabilities at the HFIR and SNS at ORNL

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Knowledge of the crystallographic preferred orientation of a polycrystalline material provides critical information needed to both predict how the material will behave in service, and understand how and why the material failed in operation. While EBSD and X-ray techniques are routinely used to quantify texture, these approaches are surface sensitive. The obtained surface information is not always representative of the bulk. In contrast, the high penetration nature of neutrons make them ideal for investigating bulk textures. HIPPO had served the scientific community since the early 2000s. However, the loss of the user program at the Lujan center has severely constrained access to HIPPO. While not specifically designed for texture analysis, instruments at the HFIR and SNS at ORNL are well suited to address the needs of the scientific community. This poster will present recent work on quantifying crystallographic textures in materials using various instruments at the HFIR and SNS at ORNL. For example, work at HB2B at the HFIR on additively manufactured 718 Inconel has demonstrated that the processing parameters can