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ORIENTATION DISTRIBUTION FUNCTION ODF DRAWN INTO THE STANDARD PROJECTION (001)

FUNKCJA ROZKŁADU ORIENTACJI (ODF) PRZEDSTAWIONA W PROJEKCJI STANDARDOWEJ (001)

Description of a new programme ODFSPx.EXE for drawing the ORIENTATION DISTRIBUTION FUNCTION (ODF) into the Standard projection (001) and its applications to display the texture of selected metallic specimens are presented.

W pracy opisano nowy program ODFSPx.EXE do przedstawiania Funkcji Rozkładu Orientacji (ODF) w projekcji standardowej (001) i jego zastosowanie do wizualizacji tekstury próbek wybranych metali.

1. Program description

A new program ODFSPx.EXE has been set up to draw the Orientation Distribution Function (ODF) into the Standard projection (001).

Preferred orientation of crystallite in the polycrystalline samples is marked as its texture. It can be described by means of the ODF expressing the crystallite quantity in the volume unit of the sample with a specific orientation of crystallographic axes towards the axes defined for the sample.

The orientation of the crystallographic axes of crystallite in the sample towards the axes of the sample is defined by three Euler angles F2, F, F1.

Any crystallite orientation is in the sample given by three Euler angles: F1; F; F2. The ratio of this orientation is given by the ODF value. ODF is a function of Euler angles: ODF = f (F2; F; F1). This function can be visualized in so called Euler space as defined by three rectangular axes: F2; F; F1. (Fig 1-A).

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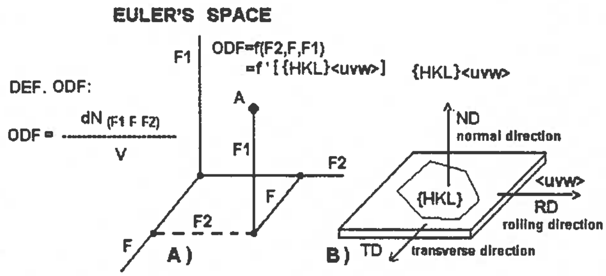

Fig. 1. (a) Euler space, (b) Ideal Orientations of the crystallite (HKL)/uvw/

To define the crystallite orientation better we introduce the concept of so called Ideal Orientations of the crystallite: (HKL)/uvw/. (Fig.1-B) (HKL): crystallographic planes parallel to the rolling plane, /uvw/: crystallographic direction in this plane and parallel to the rolling direction.

Three definite Euler agles F2,F,F1 correspond to any ideal orientation where the plane (HKL) is given by the angles F2, F and the direction /uvw/ is given by the third angle F1 (for given F2, F).

Any crystallite orientation (HKL)/uvw/ in the sample is defined by three Euler angles: F1, F and F2.

That shows the ODF as a function: ODF= f (F2, F, F1) = f' {(HKL)/uvw/}.

The texture can be shown as a diagram (and printed on paper) in two following ways:

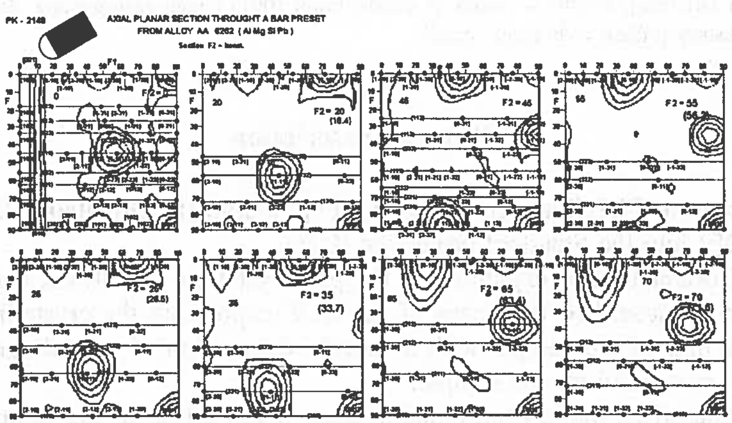

Fig. 2. Section in the Euler space for constant angles F2

1) By a Section in the Euler space namely for constant angles F2 or F1. The positions of the ideal orientations can be drawn on the respective angles F2, F1, F into the section. The rate of ODF contents in the sample can be read out from the position of the ideal orientation and the corresponding ODF values.

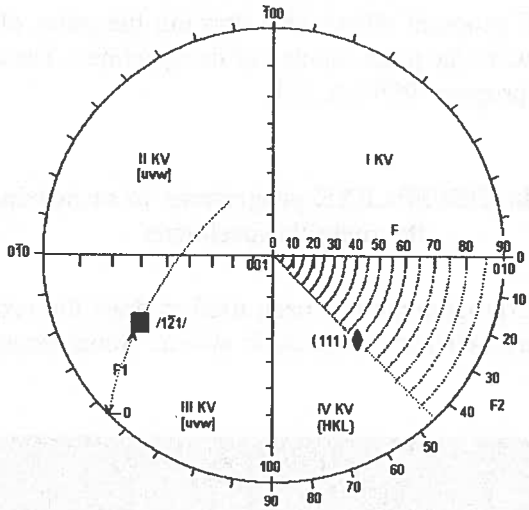

Fig. 3. Drawing the ODF into the Standard Projection (001)

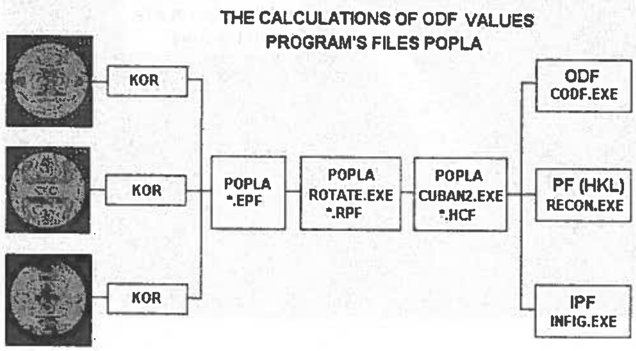

Fig. 4. The calculation of ODF values by the program POPLA

2) By drawing the ODF into the Standard Projection (001). (Fig. 3) [2]
Any point in the Euler space with F2, F, F1 coordinates defines the (HKL) and /uvw/ poles in standard projection, where the plane (HKL) is given by the angles F2, F and the direction /uvw/ is given by the third angle F1 for given angles F2, F. The ODF value related to these poles can be visualised using a colour scale. The ODF is drawn into the Standard Projection by the program: ODFSPx.EXE which was compiled on the Faculty of Nucl. Sci. and Physical Engineering CTU in Prague.

The poles of the plane (HKL) are drawn in the IVth quadrant in rhombic form; the poles of the direction /uvw/ are drawn in the IInd and IIIrd quadrants in square form.

The drawn poles (HKL) and /uvw/ are set specific domains to which it is possible to draw a network of standard projection pole.

The ODFSPx.EXE program allows also drawing the poles of the discrete ideal orientations (HKL)/uvw/ to the polar domain of the specimen. The calculation of ODF values is made by the program POPLA. [1]

2. Applications of the ODFSPx.EXE programme to measuring the textures of the metallic specimens

The ODFSPx.EXE programme has been used to draw the textures on numerous specimens of metals crystallising in the cubic system. Some examples are shown on pictures below.

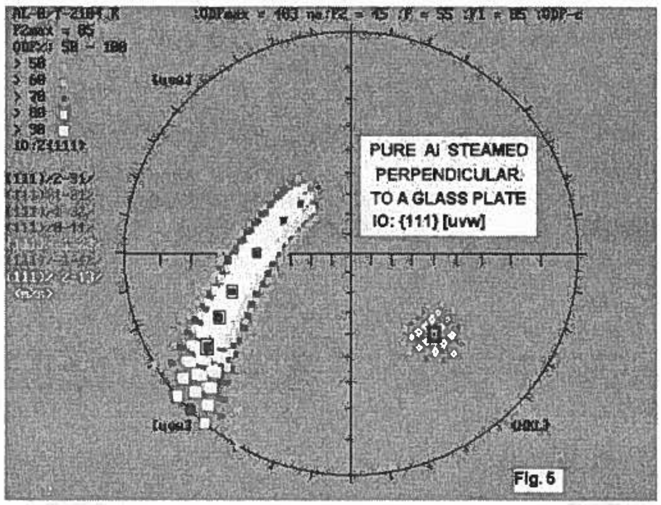

Fig. 5. Texture of pure aluminum steamed perpendicularly to a glass basic plate

Texture of pure aluminium steamed perpendicularly to a glass basic plate. Crystallographic planes {HKL} = {111} are parallel to the plane of the basic plate, the crystallographic directions [uvw] on this plane are found in the angular domain 0-360 grade. Some ideal orientations of the system {111}[uvw] are drawn.

Texture of an axial planar section through a bar pressed from Al-alloy: AA 6262 (AlMgSiPb). Systems of two fiber textures are evident: Fig. 6: {HKL}[111] where the crystallographic directions [111] are parallel to the axes of the bar; the crystallographic planes {HKL} are the planes of the zone with zonal axis [111]. Fig. 7: {010}[001] where the crystallographic directions [001] are parallel to the axis of the bar and the planes {010} are zonal planes with the axis [001].

Steel: C< 0.005%; hot rolling to 3.1 mm and cold rolling 50%. There are shown 3 systems of ideal orientations: Fig. 8: system near {111}[uvw] with ODFmax=469 Fig. 9: system {HKL}[0-1 1] with values ODF=80-90% ODFmax, planes {HKL} are

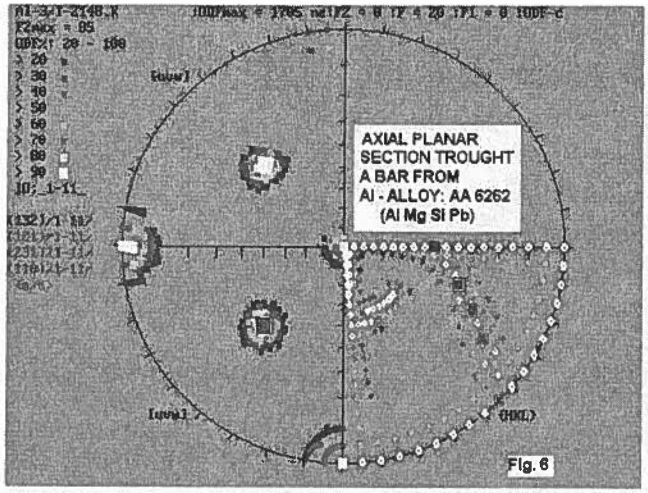

Fig. 6. Texture of an axial planar section trough a bar pressed from Al- alloy: AA 6262. Fiber texture: (HKL)[111]

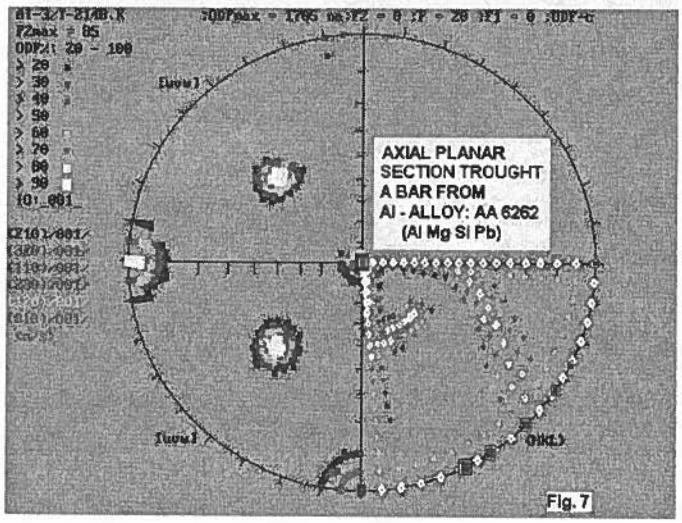

Fig. 7. Texture of an axial planar section trough a bar pressed from Al- alloy: AA 6262. Fiber texture: {010}[001]

the planes of the zone with zonal axis [0-1 1], and ideal orientation {010}[101] with ODFmax=80-90% ODFmax.

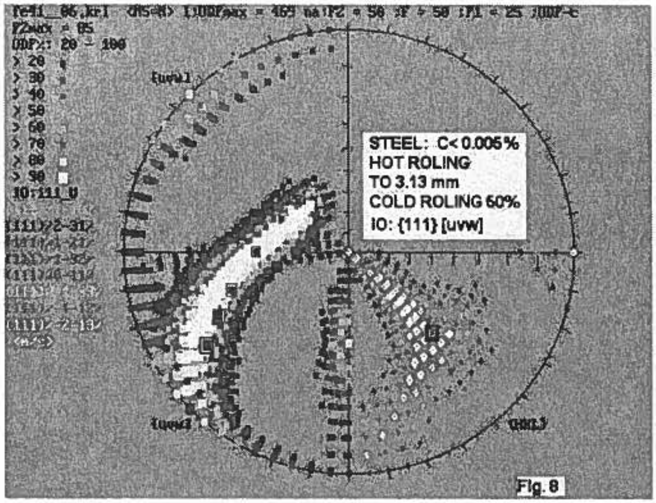

Fig. 8. Texture of steel C< 0.005%; hot rolling to 3.1 mm and cold rolling 50%. System of ideal orientations {111}[uvw]

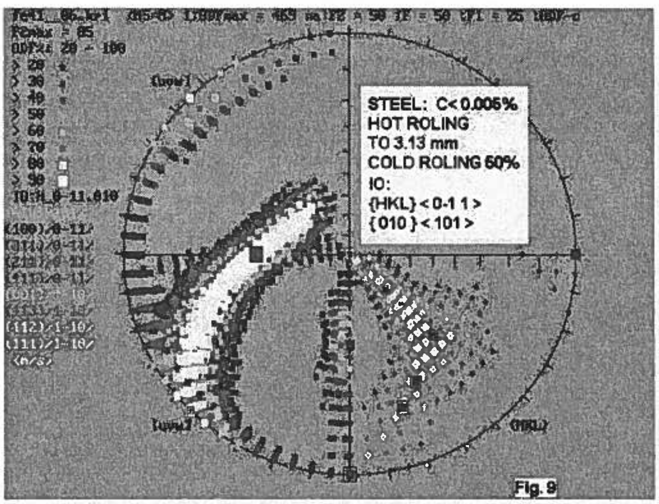

Fig. 9. Texture of steelC< 0.005%; hot rolling to 3.1 mm and cold rolling 50%. Systems of ideal orientations {HKL}[0-1 1] and {010}[101]

3. Conclusion

The above contribution presented the ODFSPx.EXE programme for visualising the texture values ODF in the standard projection (001) and showed the examples of application to real measured specimens of metallic materials. The specimens were selected to give documents of accuracy — see the concentration of texture maximums around the pole {111} and [1-1 1] respectively.

Physical Engineering CTU has elaborated a standard measuring Procedure for the cubic- system specimens, so that texture analysis Results are mutually comparable.

Acknowledgements

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