Fiber textures revisited

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Abstract

For plasma-facing components of future fusion reactors a particular type of metal matrix composites is considered: tungsten fiber-reinforced tungsten composites where a thick tungsten layer is chemically vapor deposited on thin drawn tungsten wires. Composites containing a single deformed tungsten wire in a coarse-grained tungsten matrix show unique textures. Due to oriented growth of elongated grains along $< 100 >$ directions and the cylindrical symmetry of the model composite, the matrix layer develops a cyclic $< 100 >$ ring fiber texture in general. Such ring fiber textures have been discussed long before, but never reported experimentally. In certain cases, the matrix even adapts additionally the preferred alignment of a $< 110 >$ direction along the wire axis from the $< 110 >$ fiber texture of the drawn tungsten wire and a cyclic $\{100\} < 110 >$ fiber texture develops similar to the texture of tubes. The required methodology for resolving cyclic textures from spatially resolved orientation data (obtained by e.g. electron backscatter diffraction) is presented and discussed: analyzing orientations in an appropriate cylindrical coordinate system allows identification of these peculiar texture types and quantification of specific cyclic texture components in terms of volume fractions and texture sharpness in dependence of the distance from the center of the composite. Applying the same method to the drawn tungsten wire reveals the presence of a cyclic $\{110\} < 110 >$ fiber texture component additional to an ideal $< 110 >$ fiber texture becoming weaker towards the wire perimeter.

Keywords: Fiber texture, Ring fiber texture, Cyclic texture, Texture classification, Quantitative texture analysis, Heterogeneity

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