X-RAY DIFFRACTION STUDY OF ANISOTROPIC STATE OF RESIDUAL STRESS AFTER DOWN-CUT AND UP-CUT FACE GRINDING

Zdenek PALA[1], Nikolaj GANEV[1], Jan DRAHOKOUPIL[1,2]

[1]Department of Solid State Engineering, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Trojanova 13, 120 00 Prague, Czech Republic
[2]Department of Metals, Institute of Physics, ASCR, Na Slovance 2, 182 21 Prague, Czech Republic

Machining by face grinding is inherently an anisotropic surface treatment and, therefore, ground surfaces are palpable examples that epitomize anisotropy in residual stresses (RSs). In particular, normal RSs frequently vary significantly in value and character (i. e., tensile or compressive), appreciable shear RSs occur in the direction of grinding and gradients of RSs are present even in shallow depths of several micrometers in thickness. Moreover, during face grinding two fundamentally different processes of material removal are alternately in progress – up-cut and down-cut grinding. The contribution focuses on a detailed X-ray diffraction analysis and electron microscopy investigation of the above mentioned regimes of grinding.

Studied samples, which were manufactured from three types of steels – mild carbon steel *C45*, corrosion-resistant steel *M300* and high speed steel *M41*, underwent annealing before the actual grinding by a corundum abrasive wheel. Macroscopic residual strains were measured in six azimuths φ for both positive and negative tilts ψ and the calculation of macroscopic RSs was performed by using Dölle – Hauk and least square fitting method. Microscopic RSs and mean coherent scattering domain sizes were evaluated by single line profile-fitting method for each obtained {211} diffraction peak of ferrite in order to unveil possible direction-dependent dissimilarities. The geometry of the diffraction experiment was considered carefully with regard to the sense of rotation of abrasive wheel and to the translation of sample.