RESIDUAL STRESS DISTRIBUTION BELOW SUBSURFACE CARBURIZED LAYER IN CARBON STEEL GEAR BY NEUTRON DIFFRACTION

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Residual strain and stress distributions below subsurface carburized layer in motorcycle transmission gear were nondestructively measured by neutron diffraction in order to understand deformation behavior of gear after carburizing and quenching. The material used in this study was chromium-molybdenum steel. The transmission gear was quenched and tempered after carburizing. Using cut gear, the carburized case depth was first determined by microscope and measuring hardness distribution. Second, diffraction angles below subsurface carburized layer were measured by scanning neutron beam of 2 millimeters-square along axial direction near the internal spline. The diffractions from Fe-110 and 211 planes were used, and axial, radial and hoop residual strains were obtained from the lattice spacing change. Reference coupon cubic specimens with a width of 2 millimeters were cut from the same carburized gear, and then lattice spacing was measured as stress-free one. Axial, radial and hoop residual stresses were calculated on the assumption that axial, radial and hoop residual strains were principal strains. As the results, each residual strain distribution near the internal spline along the axial direction was found to be not uniform in carburized gear. Large tensile residual strain parallel to the axial direction was generated in the shift fork groove. And tensile residual strains parallel to the axial and hoop directions were also generated in the gear wheel. Furthermore, the maximum tensile residual stress was observed parallel to axial direction at the shift fork groove. By measuring residual stress distributions below subsurface carburized layer, the inside base layer of transmission gear was found to be locally deformed, and then the shape of gear was locally changed after carburizing and quenching.