RESIDUAL STRESS MEASUREMENTS USING SYNCHROTRON X-RAY ON NICKEL-BASED SUPERALLOY AT CRYOGENIC TEMPERATURES

by

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High-cycle fatigue properties of Ni- and Ti-alloys at cryogenic temperatures have recently been investigated with the goal of improving the reliability of launch vehicles. Some unique fatigue behaviors have been reported especially for shot-peened samples of the alloys. In this study, residual stress distributions beneath the surface of a shot-peened Ni-based superalloy INCONEL718 were measured at cryogenic temperatures from 5K to room temperature using monochromatic high energy synchrotron x-rays in SPring-8. The effects of the temperature dependence of the residual stress on the fatigue behaviors were discussed.

The compressive residual stress was introduced into the surface to a depth about 120 μm by shot-peening. The changes in residual stress distributions with temperature were observed within about 50 μm depth from the surface. The maximum residual stress just beneath the surface increased with decreasing temperature. The residual stress distribution deeper than 50 μm was not changed in spite of the temperature changes.

The changes in the fatigue crack initiation sites from the surface at room temperature to inside at cryogenic temperatures can be explained by the results obtained in this study; namely, the temperature dependence of the residual stress just beneath the surface.