

RESIDUAL STRESS MEASUREMENT WITH GADDS MICRODIFFRACTION SYSTEM

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Residual stress - area detector - microdiffraction - GADDS - DIFFRAC^{plus} Stress

This is an example of residual stress measurement with GADDS Microdiffraction System. The residual stress on the inside surface of a spring was measured with Cr tube and 0.3mm collimator. Since the size of the spring is relatively small (coil diameter 10mm, wire diameter 1mm and coil pitch 4mm) the Laser Video Sample Alignment System was used to position the inside surface of the spring. The spring was made of precipitation hardenable stainless steel 17-7PH. The (211) diffraction ring of the alpha phase was used for stress measurement.

Fig 1. shows the laser spot on the inside surface of the spring wire. When the laser spot is in the center of the crosshair the sample surface is aligned to the goniometer center.

Fig 2. shows a part of the spring. The incident x-ray beam and diffracted beams can pass through the gap between spring wires so the residual stress can be measured nondestructively.



Figure 1: The image from the laser video sample alignment system.



Figure 2: The video image showing a section of the spring. Both incident and diffracted beams can pass through the gap between the wires.

Fig 3. shows one of the measured frames with chi-integrated profile. The broken blue lines indicate the shadow of the wires. For data evaluation, the frames were first processed with the GADDS stress function and then imported to DIFFRAC^{plus} Stress software for stress analysis.

The results are listed in Table 1. The ψ tilt is achieved by iso-inclination (Ω scan). The residual stress values determined in scans of 7 and 19 steps agree very well. The 19 points measurement has a lower standard deviation, about 3.5%.

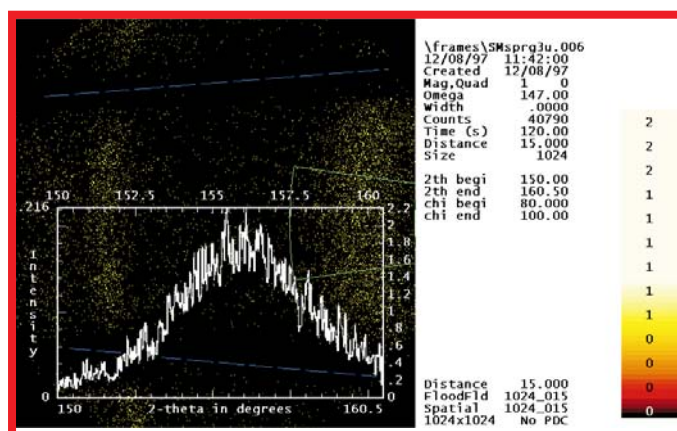


Figure 3. A measured frame with chi-integrated profile. The green broken line box defines the chi integration region. The blue broken lines indicate the shadow of the wires.

Table 1. Residual stress measurement results of the inside surface of a stainless steel spring.

Number of frames	7	19
ψ angles and steps	-45° to 45°, 15° steps	-45° to 45°, 5° steps
Data collection time	14 minutes	38 minutes
Measured stress	-864 (\pm 48) MPa	-875 (\pm 31) MPa
d vs. $\sin^2 \psi$ plot		

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