# Spatially resolved texture and microstructure evolution of gas gun deformed SUS304 steel using neutron diffraction

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Crystallographic phases in deformed SUS304 stainless steel and, in particular, the formation mechanism of the two martensitic phases (α' and ε') formed by strain-induced martensitic transformation, have long been investigated but there are few reports on their quantitative analysis and texture.

In this study, we report characterization of a 38.1mm-long and 7.62mm-caliber SUS304 cylindrical projectile produced by additive manufacturing. The projectile was accelerated to 235 m/s using the Taylor Anvil Gas Gun Facility at Los Alamos National Laboratory, impacting a high-strength steel anvil, leading to a huge strain gradient inside the sample. Spatially resolved neutron diffraction measurements on the HIPPO and SMARTS beamlines at LANSCE with Rietveld and single peak analysis were used to quantitatively evaluate volume fractions of α, β, and ε-phases as well as residual strain and crystallographic texture, which were complemented by EBSD analysis, thus providing a complete picture of the bulk micro-structural evolution. Figure 1 shows the schematic diagram of sample setting for HIPPO neutron diffraction.

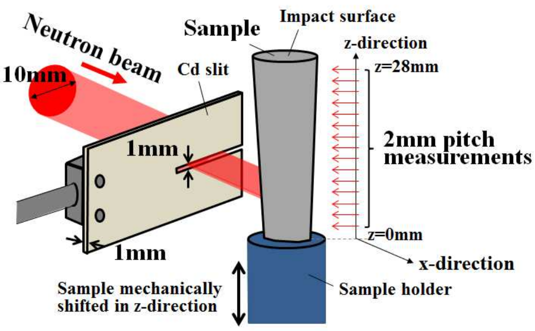


Figure 1: Schematic diagram of sample setting for HIPPO neutron diffraction.

Figure 2 shows the neutron diffraction patterns near α(110) peaks. Interestingly enough, small peaks for ε-phases were detected only at the intermediately deformed positions of the sample. From the analysis, it was clarified that the α-phase was increased up to 5 volume percent by the strain imposed during the deformation and no more than 1 volume percent of ε-phase was formed in the very slightly deformed volume where little amount of α-phase was detected. These results suggested that the evolution of α (α') phase during strain-induced martensitic transformation was hardly influenced by the existence of ε-phase. Further results and discussion will be presented in the session.

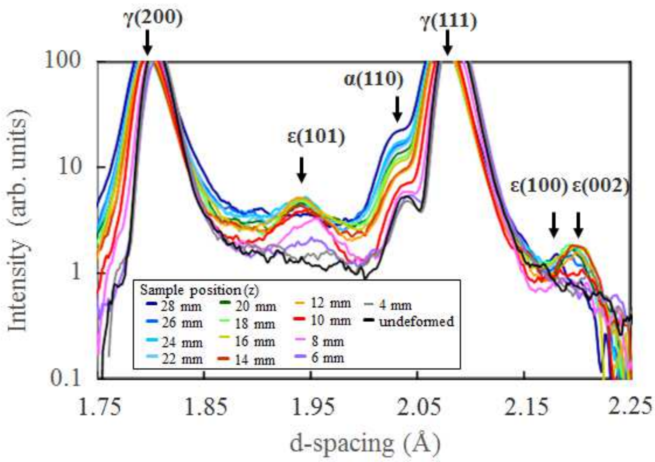


Figure 2: Neutron diffraction patterns near α(110) peak.
Deformation rate became more severe at the higher sample position z.