In-situ observation of impact tensile deformation depending on sampling direction in heavy rolled fine grain metals by using synchrotron radiation

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Abstract

It has been reported that heterogeneous-nano structured materials fabricated by severe plastic deformation in low SFE metals show excellent mechanical properties. Currently, not only optimization of fabrication process but also mechanical properties, such as strain rate and temperature dependence, have been investigated in the heterogeneous-nano structured materials. In this study, impact testing machine for in-situ observation on the beam line in Japanese synchrotron radiation facility, SPring-8 is developed to investigate high-speed deformation and fracture in the heavy rolled metals with the heterogeneous-nanostructure. The experiment was carried out at beam line 20B2 (40 keV) and 47XU (37.7 keV) in SPring-8. 2D detector, which is visible-light conversion type consist of scintillator, optics lens and high-speed camera, was utilized for high-speed X-ray imaging of 50000 fps. A set-up for taking X-ray computed tomography was also installed on the beam line to observe internal voids caused by deformation on failure samples. As an additional measurement instrument, global and local X-ray diffraction was tried to monitor by using flat panel and 2D detectors during impact fracture test. The sample used in this study are a commercial purity titanium and a stainless steel. The load was applied to specimens cutting along the rolling direction (RD) and transverse direction (TD) by impact of dropping weight and was measured by strain gauge via signal conditioner. The difference of fracture behaviors in RD and TD samples had been successfully captured during impact tensile test depending on the texture.

Keywords: in situ observation, synchrotron radiation, high speed imaging, impact test

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