

Application to the steel material of the mechanical properties of the micro analysis region using nanoindentation



Key Word ; nano indentation test, AFM, mechanical property of micro field

Nobuo Nagashima

Analysis and Evaluation Field / Environmental Fatigue Evaluation Group

NAGASHIMA.Nobuo@nims.go.jp | https://samurai.nims.go.jp/profiles/nagashima_nobuo?locale=en



Background Necessary due to technological development and microstructure control in the steel industry, Know the mechanical properties of the micro region is increasing. Nano indentation test is one of the mechanical property evaluation methods at these micro fields.

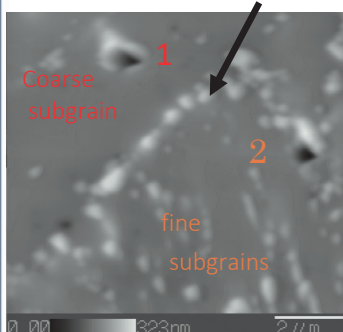
Aim By nanoindentation testing machine having a function positioning hardness measurement of high precision, we evaluate the mechanical properties of the micro region, at any point in the sample.

Advanced Research Topics

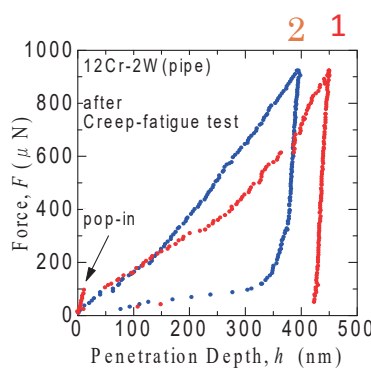
Characterization of mechanical properties for creep-fatigued ferritic heat-resisting steel by nano-indentation

Sample : 12Cr-2W steel, tube, Creep-fatigue test failure specimen (Creep-fatigue lives 309cycles)
 Creep-fatigue test conditions : 650°C, The total strain range for a trapezoidal wave was 1.0% and the strain hold-time was 10.8 ks. The initial strain rate was 5×10^{-4} /s.

Prior γ grain boundary



AFM image



F-h depth curve

The creep fatigue test, coarse subgrains are formed in the prior austenite grain boundary neighborhood.

As for indentation examination 1 in the coarse subgrain, pop-in phenomenon was observed early in F-h curve. This result understands that dislocation density is extremely low. On the other hand, as for indentation examination 2 in the fine subgrain, indent depth is shallow, and pop-in is not observed.

From these results, dislocation recovery produced conspicuously it at the subgrain that became a coarse size in a prior- γ grain boundary neighborhood.

Publications

•Nobuo NAGASHIMA, Masao HAYAKAWA and Megumi KIMURA, "Characterization of Mechanical properties for creep-fatigued ferritic heat-resisting steel by nano-indentation", Procedia Materials Science 3(2014), pp.2006-2010.

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Applied area and future prospects

- Evaluation of non-uniformity of steel materials
- Evaluation of Damage of Micro Region of Steel Material

Issues for technology transfer

As devices get higher performance, mechanical characterization on the micro field will be important. This technology makes these measurement possible.