

## Study on uniaxial tensile and creep deformation of structural steel

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Creep resistant Ferritic-Martensitic steel is considered as a promising structural material for power plant applications. For such steels, intensive research have been carried out in the scientific world to understand the high-temperature deformation mechanism both through uniaxial Constant Strain Rate Test (CSRT) and Creep test at 0.3-0.5Tm. However, very few attempts were made to correlate the effective stress of CSRT with actual creep rate. The present work is an attempt to establish a relationship between these two. To characterize the stress exponent (n) and activation energy (Q) of F92 steel, experiments were carried out via Differential Strain Rate Test (DSRT) and CSRT between strain rate range of (10<sup>-5</sup>-10<sup>-3</sup>s<sup>-1</sup>) and temperatures (400-700°C). The estimated (n) and (Q) through CSRT were found to be 13 and 600kJ/mol, respectively. To rationalize high obtained values of n and Q, BMD model was used and rationalized values came to be 5 and 236±20kJ/mol, respectively. The values of n and Q were also obtained directly from DSRT and found to be 4±0.2 and 195±2kJ/mol, respectively, which are close to the values obtained from CSRT. These values reported being associated with the climb of edge dislocation deformation mechanism.

### Introduction:

Creep (sometimes called cold flow) is the tendency of a solid material to move slowly or deform permanently under the influence of persistent mechanical stresses. It can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material. Introduction, Initial microstructure, Austenitic steels, Ferritic steels, Creep at constant stress, Transient response to stress changes, Cyclic creep, Microstructural interpretation of creep rate, Basic equations, Solid solution hardening, Loading strain and initial primary creep, Transient creep response to changes in creep conditions. Tertiary creep due to subgrain coarsening, Increase of creep rate due to degradation of particle hardening, Deceleration and acceleration of creep by cyclic variation of stress, Dislocation models of creep, Kinetics of dislocation glide, Evolution of dislocation structure, Particle hardening, Composite model, In situ TEM observations of dislocation activity, Discussion and outlook, Microstructural Model Mikora. At high temperatures ceramics have favorable properties. Ceramic products are resistant to oxidation. Ceramics can be used as a moderator. ANSWER: Non-crystalline ceramics become brittle below recrystallization temperature.

A prior trend of the material science is development of new materials

### Materials & Methods

Strengthening of steel under investigation

SPD technique by ECAP. Channels intersection angle 120. To implement ECAP, PSU-125 press with the maximum load to 125 t was used. Linear dimensions of cylindrical specimens used for calculation of the accessory for ECAP realization: 100 mm in length, 20 mm in diameter. Cylindrical specimens of the corresponding dimensions were made of 09G2S steel. Steel blanks were subjected to ECAP by route Bc with 4 passages at 723K pressing temperature. Compression mold must be heated to increase plasticity of the deformed material. Also, the influence of preliminary forging and torsion of the material on the steel strength was studied. The types of thermomechanical processing of steel are listed in Table 1. The first type is steel quenching in water with the temperature of 1203K with subsequent equal channel angular pressing by route Bc in 4 passages. Preliminary steel quenching makes it possible to get more fine-grained structure in the course of ECAP realization.

### Results

Static tension tests were carried out at UTS- 20k tensile-testing machine at the constant load rate = 8.33 .10<sup>-2</sup> mm/sec at room temperature. Figure 1 gives a conventional strain diagram of 09G2S steel subjected to thermomechanical processing of the 3rd type (forging + quenching +ECAP). The strain diagram for the 4th type of steel thermomechanical processing (torsion + quenching + ECAP) is analogous. Table 2 gives mechanical properties of the investigated steel for each type of its thermomechanical processing. However, as further investigation showed, the use of additional post-deformation thermal processing makes it possible to improve brittle fracture strength properties. Table 3 gives values of impact fracture strength of the low-carbon Fe360 steel subjected to ECAP and various types of thermal processing. The values in Table 3 were taken at the test temperature of 213K. As seen in Table 3, the best results for impact fracture strength were obtained at combined type of thermomechanical processing, namely, at preliminary quenching in water with the temperature from 1203K with subsequent ECAP and post-deformation annealing. The use of post-deformation annealing (after ECAP) makes it possible to get more uniform structure with lower residual stress

**Note :** This work is partly presented at Joint Event Joint Event on 15<sup>th</sup> International Conference and Exhibition on Materials Science and Engineering & 3<sup>rd</sup> International Conference on Applied Crystallography on November 07-08, 2018 | Atlanta, USA.