Chapter VI

Conclusions

The aim of this work was to determine the differences in dynamic softening behaviour of St.15 The investigation was done by hot compression tests in austenitic and in ferritic range. By use of cylindrical specimens according to RASTEGAEV specimen geometry and glass powder as a lubricant, the stress and strain distribution in the sample are homogeneous up to high strain value. The austenitization was performed at 1250 °C for 10 minutes or at 1000 °C for 5 minutes. By this, the effect of the initial grain size on the softening behaviour can be investigated. The deformation temperatures were between 700 °C and 1250 °C or 700 °C and 1000 °C. The strain rates were 0.01, 0.1, 1, 10 /s. After deformation the specimens were quenched by nitrogen gas. The effect of deformation parameter on the microstructure was investigated by metallographic examination. Ferrite grain size was determined by comparing with standard ASTM grain size number.

For deformation in the austenitic range, the strain at peak stress in case of coarse initial grain size is higher than that in case of fine initial austenite grain size. In addition, coarse initial grain size suppresses the softening by dynamic recrystallization. Decreasing deformation temperatures or increasing strain rates delay the onset of dynamic recrystallization and extend the strain range between strain at peak stress ε_p and strain at steady state ε_s. This results in an incompletely recrystallized microstructure.

When deformation in the ferritic range, increasing strain rates or decreasing deformation temperatures results in an increase in flow stress, whereby the strain at the onset of steady state seems to be the same value. In this work recovery is the main softening mechanism in ferrite phase, the microstructure after deformation consist of elongated or deformed grains as well as subgrains. For different initial microstructure, the strain at steady state stress in case of coarse initial grain size is equal to that in case of fine initial austenite grain size. For deformation in the austenitic or ferritic range, the ferrite grain size is reduced as deformation temperature decreases, which is similar to that when increasing strain rate.

The important results from this work can be concluded as follows:

1. For deformation in ferrite phase, the main softening mechanism is prone to dynamic recovery.

2. For deformation in austenite phase, the main softening mechanism is prone to dynamic recrystallization.

3. For deformation in austenite phase with increasing strain rates, the peak stress and the steady state stress of flow curve are shifted to higher stress value.

4. For deformation in austenite phase with increasing strain rates, the strain at peak stress and the strain at steady state stress of flow curve are shifted to higher strain value.

5. For deformation in austenite phase with decreasing deformation temperatures, the peak stress and the steady state stress of flow curve are shifted to higher stress value.

6. For deformation in austenite phase with decreasing deformation temperatures, the strain at peak stress and the strain at steady state stress of flow curve are shifted to higher strain value.

7. By increasing strain rates, critical flow stresses are shifted to higher stress value.

8. The critical flow stress in the ferritic range increases more rapidly with decreasing deformation temperatures than that in the austenitic range.