Journal of Achievements in Materials and Manufacturing Engineering
VOLUME 23
ISSUE 1
July
2007

# The impact of deformation on structural changes of the duplex steel

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Received 19.03.2007; published in revised form 01.07.2007

**Materials**

## ABSTRACT

**Purpose:** Despite the many years' research on the plasticity of duplex steels, it was impossible to conclusively determine the mechanisms for structure recovery during the plastic deformation. The paper will attempt to provide explanations for the changes taking place in the steel structure during the superplastic flow.
**Design/methodology/approach:** After a solution heat treatment at 1250°C, the steel was subjected to cold deformation through rolling with the total 70% reduction. The specimens were tensioned in the "Instron" strength-testing machine at temperature 850°C at a rate of $v_r=15\times10^{-3}$ mm/s in a 0.005Pa vacuum. Structural examination was carried out using light and electron microscopy. The micro-diffraction technique was applied to provide diffraction images with Kikuchi lines.
**Findings:** A joint operation of structure reconstruction mechanisms during the deformation of the analyzed steel with the process of σ phase precipitation inhibiting further growth of the newly-formed grain has been determined.
**Practical implications:** The capacity for increased deformability through combined thermo - mechanical processes, requiring a precise selection of the deformation parameters, has been indicated
**Originality/value:** The results obtained are vital for designing an effective thermo - mechanical processing technology for the investigated steel.
**Keywords:** Superplastic materials; Plastic forming; Microstructure; Hot tensile test

## 1. Introduction

Recently, there has been a growing interest in (α+γ) duplex steels in many different industry branches, particularly on the chemical and petrochemical fronts [1-4]. Ferritic-austenitic steels are an alternative to single-phase steels characterized by an austenitic structure not only with regard to their properties but also because of the lower production costs connected with decreased amounts of nickel . These materials show very high resistance to corrosion coupled with high strength. The enhanced strength properties of two-phase steels when compared to single-phase steels, are connected with the presence of both ferrite and austenite in the steel structure, with the former affecting plasticity, and the latter possessing strengthening qualities. In many industry branches (α+γ), duplex steels of the have not been popularized well enough due to the problems they pose in shaping, resulting from the different properties of the two phases making up the material. Literature [5 - 8] provides information on plasticity tests carried out on ferritic-austenitic steels and oriented to provoke the effect of superplasticity by complex thermoplastic processes. Despite the many years' research on the plasticity of these steels, it was impossible to conclusively determine the mechanisms for structure recovery during the plastic deformation [9-12].

The influence of tension parameters on the technological plasticity and structural changes been shown in the papers [13, 14]. This paper will attempt to provide explanations for the changes taking place in the steel structure during the superplastic flow.