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Influence of microstructure on the mechanical properties of low carbon UNS S41003 stainless steel

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The UNS S41003 stainless steel is a lean stainless steel with 11%Cr, low carbon (<0.03%C), and small Ni addition. The composition is such that, depending on the processing route, the microstructure can be ferritic, martensitic, or ferritic-martensitic. Specimens aquired from the steelmaker were produced by hot rolling with coiling temperature around 400°C, with and without annealing. The batch annealing consist of a heating and cooling cycle in the range of 800 - 650°C for 24h. In this process The coilers are stacked up in a furnace with controlled atmosphere. In this work, specimens hot roled (HR) and annealed (ANN), were received from the the steelmaker. Besides these, other two set of specimens were created by heat treating ANN e HR samples at 1000°C and water quenching. The specimens water quenched were named ANN-WQ and HR-AQ. The microstructures of the four group of specimens were characterized by scanning electron microscopy (SEM) with electron backscattered scanning diffraction (EBSD), and X-ray diffraction (XRD). The mechanical properties were measured by tensile tests, hardness and impact toughness at room temperature. The results show that a wide range of properties can be produced by varying the heat treatment. The steel HR has a microstrucutre of 76% of martensite and 24% of delta ferrite, while the specimens quenched showed 100% of martensite with a high density of dislocations measured by EBSD and XRD. As a result, these specimens had high mechanical strength. The microstructure of the annealded steel (ANN) consists of equiaxial grains of alfa ferrite and intergranular chromium carbides, with low dislocation density. The ANN was very ductile, but the mechanical strenght was much lower than the HR, HR-WQ and ANN-WQ steels. The impact toughness of the HR steel was superior to the other conditions, which can be explained to the low carbon of the martensite and the fine grain size of this sample, as measured by EBSD.