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# Effect of retained austenite resulting from tempering of supermartensitics stainless steel welded

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**Abstract** – Was verified that the parameters and the process of welding used promoted the hardness, toughness and corrosion resistance appropriate to the applications of the steel. The control of the welding energy becomes an essential factor and it could affect the temperature of carbides precipitation and the nucleation of the austenite retained in the region of the heat affected zone.

The difficulties found in the welding of conventional martensitic stainless steel at the end of the 60s led to the development of a new class of martensitic stainless steel, called supermartensític stainless steel, was introduced into the oil industry. This alloy was developed as a practical and economical alternative to carbon steel and corrosion inhibitors, replacing some of the duplex stainless steels used in offshore pipelines [1-3].

The supermartensitic stainless steel is applied to enlarge the technological advantages associated to the low costs, and combine good mechanical properties, weldability, toughness and corrosion resistance.

The control of the thermal cycle in the welding process has fundamental importance regarding the properties of the weld, particularly in the heat affected zone.

Heat treatment of steel was carried out as follows: austenitizing temperature of 1050℃ for 2 hours and air cooling up to room temperature. Subsequently, tempering at 670℃ during 10 hours followed by air cooling. The steel's microstructure was characterized by X-ray diffraction (XRD). Furthermore, it was verified that the parameters and the process of welding used promoted the hardness, toughness and corrosion resistance appropriate to the applications of the steel. The control of the welding energy becomes an essential factor and it could affect the temperature of carbides precipitation and the nucleation of the austenite retained in the region of the heat affected zone (ZAT).

In supermartensitic alloys, the Cr and Ni ratio equivalents promote the formation of a martensite and retained austenite microstructure. The retained austenite phase may represent a volume of only a few percent (characteristic of low alloy) up to 40% (characteristic of high alloy), but it is nevertheless very difficult to identify because it is dispersed in the martensitic structure. The presence of retained austenite is beneficial to supermartensitic alloys because it promotes the dissolution of Mo and Cr carbide, increasing the content of these elements dissolved in the matrix.

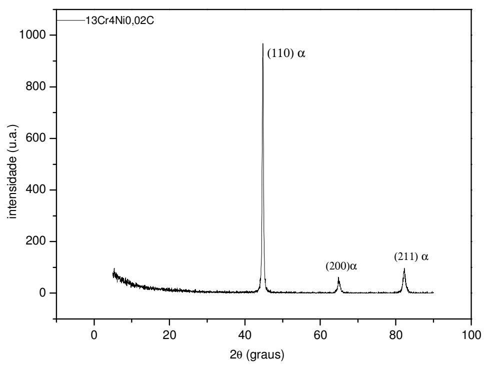


**Figure 1:** XRD diffraction spectra of the stainless steel after tempering.

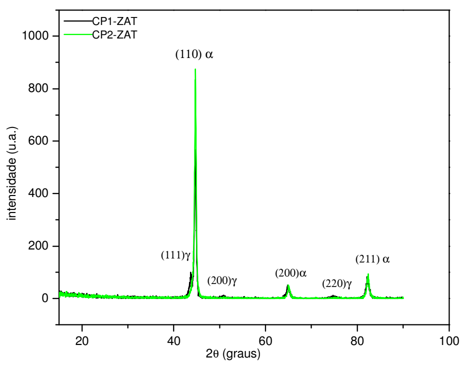


**Figure 2:** XRD diffraction spectra of the stainless steel welded.

## References

[1] P.D. Bilmes et al. Materials Characterization, v. 46 (2001) p. 285-296.
[2] J. F. Sobrinho, N.G. Alcântara. Centro Federal de Educação Tecnológica do Piauí, João Pessoa (2007).
[3] D. S. Leem et al. Scripta Materialia, v. 45 (2001) p. 767-772.