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Effect of the superficial layer containing carbides on the properties of low-temperature carburized austenitic stainless steel: characterization of the superficial layer

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Low-temperature thermochemical treatments of austenitic stainless steels (nitriding, carburizing, etc.) have reached a sufficient state of maturity to be applied at industrial scale. For instance, the SAT12 gaseous process from Swagelok allows to bulk handles millions of ferrules per year, in nominal sizes ranging from 6 to 25 mm. Whatever the process (gaseous phase, plasma) used for carburizing, the obtained layers are reported to be only made of a metastable supersaturated fcc carbon solid solution containing up to 12 at.% of carbon (expanded austenite with carbon or g_C phase). However, the superficial layer resulting from a low-temperature plasma carburizing treatment of AISI 316L is very rich in carbon (up 60 at.%) and contains carbides as it will be presented in this communication. As a matter of fact, transmission electron microscopy (TEM) and sometimes X-ray diffraction (XRD) observations reveal the presence of M_5C_2 (or χ-phase). The χ particles have the crystal structure of Fe_5C_2 (“Hägg carbide”) with very similar lattice parameters.
To study the characteristics of this superficial layer, several samples in AISI 316L were carburized together in a plasma reactor (microwave source). A plasma mixture of $Ar/H_2/C_3H_8$ and a temperature of 420 °C were the conditions used during the 4 hours of treatment. Using our remote plasma device, it is possible to partially remove the superficial layer by sputtering in Ar/H_2 gas mixture. In order to evaluate the role of the superficial layer on the tribological and corrosion properties of carburized samples, part of them was submitted to this post-carburizing process.
The purpose of this communication is to present the characterization of the superficial layer containing carbides. Different types of analyses were performed: GD-OES, XRD, TEM and SEM.

Keywords
carburizing