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Magnetic and Microhardness Study of the 17-4PH Steel

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17-4 PH steel is a high-strength stainless steel with exceptional corrosion resistance. It has a wide range of applications, including its use in aerospace components, medical implants, and the chemical, petrochemical, food processing, paper, and general metalworking industries. Through aging treatments, which involve adjusting the time and temperature, the specific properties of this steel can be fine-tuned to suit any particular application. This study primarily aimed to analyze the tribological and magnetic properties of commercial 17-4 PH steel. This steel's chemical composition contains Fe, Cr, Ni, Cu, Mn, Si, Nb and C. It was aged isochronally but subjected to different temperatures. Plate samples, approximately 2 × 1.5 × 0.2 cm in size, were cut from a laminated piece and solubilized at 1050°C for 1 h. They were subsequently individually aged in a vacuum for 1 h at temperatures of 480, 566, 593, and 620°C. X-ray diffraction, microhardness (HV), magnetization versus applied magnetic field [M(H)], and Mössbauer spectroscopy were used to characterize these samples. The as-solubilized sample was mainly composed of martensite with minor phases of austenite and niobium carbide. The aging process induced further austenite precipitation, which increased with the treatment temperature, while the NbC fraction remained relatively unchanged. At the lowest aging temperature, the sample displayed a peak microhardness of 430 HV, a 30% increase compared to the solubilized sample (330 HV). A similar pattern was noted in the saturation magnetization, with maximum value in the sample aged at 480°C and minimum value in the sample aged at 620°C. The magnetic hardness showed minor variations between samples, with magnetic coercivity ranging from 50 to 70 Oe and remanence of approximately 18 ± 2 emu/g. The study also discusses the relationship between the characteristics and quantities of phases in the aged samples (i.e., martensite, austenite, and intermetallic compounds precipitates) and their tribological or magnetic properties.