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Anisotropy of the elastic and magnetic properties of expanded austenite in AISI 316L stainless steel.

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The correlation between the grain orientation and the magnetic and elastic properties of plasma nitrided polycrystalline 316L austenitic stainless steel (ASS) is investigated.Plasma nitriding was performed at 400°C for 30 minutes under a pressure of 7.5 Pa using a 60 sccm N_2 and 40 sccm H_2 mixture. The grain orientation in a delimited area was obtained from electron backscatter diffraction (EBSD). The magnetic properties of the assessed grains were locally investigated by polar magneto-optical Kerr effect (MOKE) and magnetic force microscopy (MFM). Young's modulus E_{hkl} cartography was obtained in 3D using nanoindentation tomography. Plasma nitriding results in the nitrogen incorporation into the octahedral sites and expansion of the ASS lattice. This induces ferromagnetism at room temperature due to the formation of expanded austenite, where the diverse grains exhibit different magnetic properties, with a resulting effective magnetic easy axis along an unusual direction. Moreover, nitriding results in a complete reversal of the elastic behavior anisotropy: while the non-nitrided 316L ASSshows the typical elastic anisotropy of fcc-type metals with a maximum of E_{hkl} for the <111> oriented grains, the maximum of E_{hkl} is observed for the <100> oriented grains in the expanded austenite. These observations are discussed on the basis of the expansion due to the nitrogen incorporation and associated lattice rotation and residual stress effects.

Keywords
plasma nitriding
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