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Magnetic Layer Formation on Plasma Nitrided CoCrMo Alloy

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It is now well-established that nitrogen incorporation into fcc FeCrNi stainless steels by various ion beam techniques at a relatively low substrate temperature of ~ 400 ºC leads to a high-N content phase, γ_N, in the treated layers. This phase, known as the expanded austenite phase, depending on its N contents and associated lattice expansions, is found to have both ferromagnetic and paramagnetic characteristics. Recent studies indicate that a similar expanded phase can also be formed on the surface of CoCrMo alloys. The preliminary findings here suggest ferromagnetic type of behavior for the γ_N layer on the CoCrMo substrate alloy. In the present study, the formation of the expanded austenite phase is facilitated by R.F. plasma nitriding of a medical grade CoCrMo alloy at 400 ºC under a gas mixture of 60% N_2 – 40% H_2. The magnetic state of the γ_N layers was determined by a surface sensitive technique, magneto-optic Kerr effect (MOKE) and with a scanning probe microscope in magnetic force mode (MFM). The hysteresis loops for the nitrided CoCrMo specimens demonstrate ferromagnetic type behaviour. The ferromagnetism in the γ_N layers is also revealed by the observation of stripe domain structures in the MFM images. The ferromagnetic state for the γ_N phase observed here is linked to large lattice expansions (~ 10%) due to high N contents (~ 30 at.%), and may be correlated with the volume dependence of the magnetic properties of fcc γ-Fe.

Keywords
Plasma nitriding
XRD
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