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The effects of treatment temperature on the structure and corrosion-resistance of AISI304 stainless steel treated by low voltage plasma immersion ion implantation

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Low voltage plasma immersion ion implantation (PIII) has been demonstrated to have great potentials in industrial applications. The process is characterized by a thin plasma sheath and high ion flux compared to conventional high-voltage elevated-temperature plasma immersion ion implantation. Hence, it is more suitable for samples with an irregular shape. Our work on AISI304 stainless steel materials shows that both the tribological properties and corrosion resistance of the treated samples can be enhanced by this method. In this paper, we focus on the effects of the treatment temperature on the structure and corrosion resistance of the samples at a sample bias of 2kV. After treatment, expanded austenites (γ_N) is formed in the top surface layer as revealed by glancing-angle x-ray diffraction (XRD), and the amount of the γ_N phase increases with the treatment temperature up to 450°C. Meanwhile, the thickness of the modified layers varies exponentially with the sample temperature. The corrosion resistance is also substantially enhanced as shown by polarization test and SEM. The polarization curves demonstrate that the electrochemical properties also depend on the treatment temperature. In fact, the synergetic effect of the sample temperature and high ion flux (dose rate) determines the final surface properties of the treated samples.

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Polar Flux Symmetry in Z-pinch-driven Hohlraums using a Self-backlit Foam Ball Diagnostic

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In Z-pinch experiments on the Z accelerator [1], we are evaluating the feasibility of using a radiation-driven vacuum secondary hohlraum for indirect-drive ICF [2]. To develop a system with the potential to scale to ignition and high yield, we must demonstrate a high degree of radiation flux symmetry at the capsule position [3,4]. In initial experiments with single-sided illumination of the secondary, we have used a 5.0-mm-diameter low density foam ball imaged by a gated x-ray framing pinhole camera looking through a 6.5-mm tamped aperture to diagnose the large time-dependent asymmetry in polar radiation flux [5]. For peak hohlraum radiation temperatures in the range of 70 – 100 eV, foams of about 50 mg/cc will support a transonic radiation front propagating with a sharp total transmission edge (combined foam self-emission and transmitted hohlraum wall backlight). The transmission edge can be tracked for comparison with radiation-hydrodynamics and 3D radiosity simulations.

This technique is currently being applied to polar flux symmetry measurements in a highly symmetric configuration [1], where the hohlraum is heated to 75 eV by Z-pinches on opposite ends of the secondary driven by a single current feed. The foam ball technique should be adequate to diagnose near-term symmetry control experiments where the side-to-side pinch power imbalance is expected to be ≥15%. As the pinch balance is improved to less than 8%, accurate time-dependent drive symmetry measurements will require framing pinhole cameras with higher spatial resolution imaging laser-backlit shells or capsules in a secondary without diagnostic apertures.

[1] M. E. Cuneo *et al.*, Bull. Am. Phys. Soc. **44**, 40 (1999), and this conference.
[2] J. H. Hammer *et al.*, Phys. Plasmas **6**, 2129 (1999).
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[4] S. G. Glendinning *et al.*, Rev. Sci. Instrum. **70**, 536 (1999).
[5] D. L. Hanson *et al.*, Bull. Am. Phys. Soc. **44**, 40 (1999).

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