

## Plasma nitriding on chromium electrodeposit

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This paper presents some results of plasma nitriding on hard chromium deposit. The substrates were C45 steel and 30~50  $\mu\text{m}$  of chromium deposit by electroplating was formed. Plasma nitriding was carried out in a plasma nitriding system with 95 $\text{NH}_3$  + 5 $\text{CH}_4$  atmosphere at the pressure about 600 Pa and different temperature from 450°C to 720°C for various time. Optical microscopy and X-ray diffraction were used to evaluate the characteristics of surface nitride layer formed by nitrogen diffusion from plasma atmosphere inward Cr coating and interface carbide layer formed by carbon diffusion from substrate outward Cr coating. The microhardness was measured using microhardness tester at the load of 100 gf. Corrosion resistance was evaluated using the potentiodynamic measurement in 3.5% NaCl solution. A saturated calomel electrode (SCE) was used as the reference electrode.

Fig.1 shows the typical microstructures of top surface and cross-section for nitrided and unnitrided samples. After plasma nitriding a sandwich structure was formed consisting of surface nitride layer, center chromium layer and interface carbide layer. The thickness of nitride and carbide layers was increased with the increase of processing temperature and time. Hardness reached about 1000Hv after nitriding while 900Hv for unnitrided hard chromium deposit. X-ray diffraction indicated that surface nitrided layer was a mixture of  $\text{Cr}_2\text{N}$  and  $\text{CrN}$  at low temperature and  $\text{CrN}$  at high temperature (Fig.2). Anodic polarization curves showed that plasma nitriding can greatly improve the corrosion resistance of chromium electrodeposit. After plasma nitriding, the corrosion potential moved to noble direction and passive current density was lower by 1 to 4 orders of magnitude compared with chromium deposit (Fig.3).

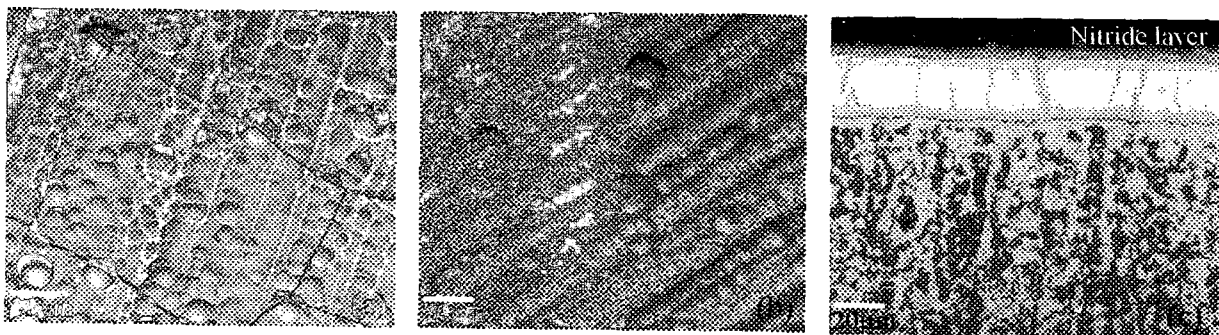


Fig. 1 Microstructures of nitrided and unnitrided samples (a) top view of Cr deposit (b) top view of nitrided Cr deposit (c) cross-sectional microstructure of nitrided Cr deposit

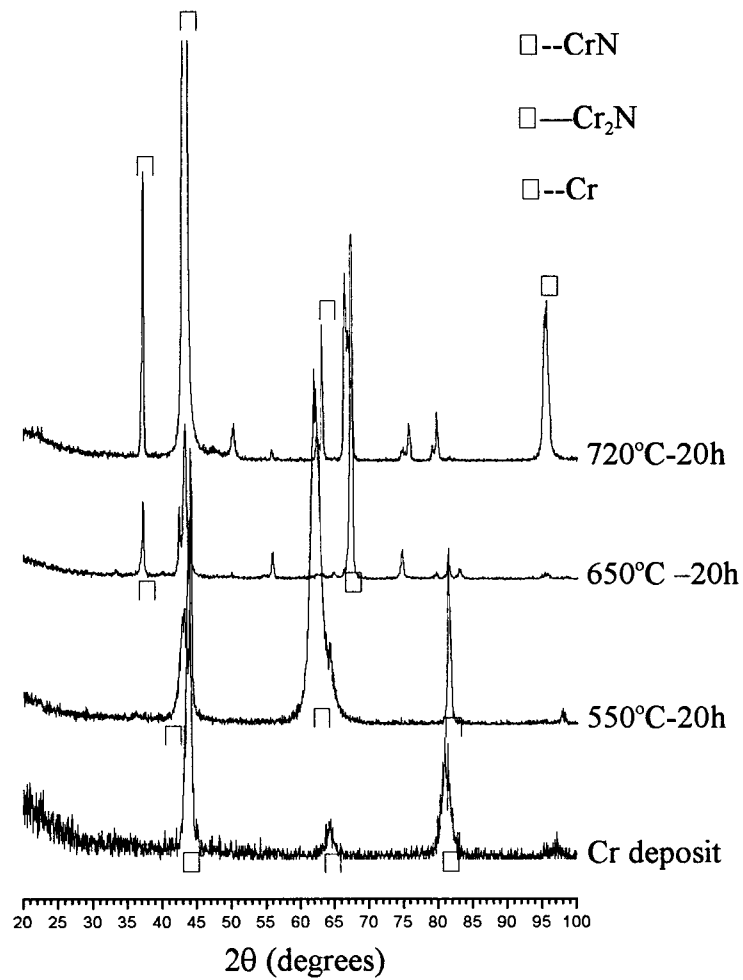


Fig.2 X-ray diffraction patterns for nitrided and unnitrided samples

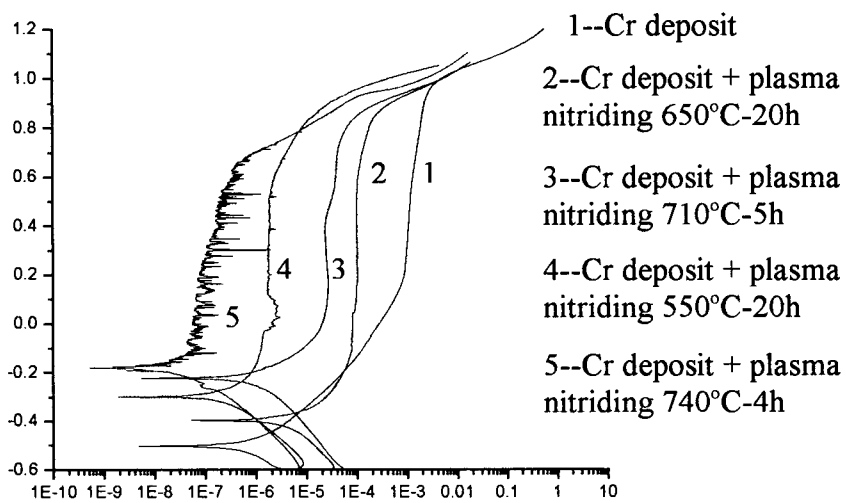


Fig.3 Polarization curves in 3.5% NaCl aqueous solution