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Mechanical Properties and Corrosion Studies of Nitrogenated Carbon on Magnetic Head Prepared by Filtered Cathodic arc Deposition

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INTRODUCTION

Ultra-thin diamond-like carbon (DLC) film is coated on magnetic head to provide mechanical protection and to protect the head against corrosion. Nowadays, filtered cathodic arc(FCA) deposition has been accepted as new technology for 1.5-2 nm DLC of magnetic head[1], however, far less work has been reported to study the nitrogenated carbon (CN_x) film doped by nitrogen in FCA deposition.

EXPERIMENT DETAILS

Nitrogenated carbon films were deposited by the off-plane double bend FCA system[2], N_2 controlled by flow rate was induced in the process chamber and the carbon ions were deposited on the head.

RESULTS AND DISCUSSION

(A) Microstructure analysis: Raman spectroscopy was used to study the microstrcutre of the CN_x film, all spectra exhibited a broad Raman intensity distributed in 1100-1900 cm^{-1}, no obvious peak which corresponds to the stretching vibration of sp1 C≡N bonds was found. The main asymmetric peak was fitted with 2 Gaussian peaks, graphite (G) and disorder (D) peaks, from analysis of G & D band positions and intensity ration of D, G lines, significant shift of G band was found for high N doping film.

(B) Young's modulus and hardness: Mechanical property was characterized by Young's modulus and hardness. For DLC & low N doping film, the elastic modulus was about 275 Gpa while the value decreased to about 200 Gpa for high N doping film. The hardness is weak dependent on N doping content, the maximum hardness (60 Gpa) occurred at the lowest values of N content, but it kept at the range of 40-50 Gpa on high N doping content (N_2 flow rate of 20-30 sccm). The hardness of CN_x films was lower than that of DLC is due to the decrease of sp^3 carbon-carbon bonding upon N incorporation.

(C) Surface morphology: Morphology relates to film coverage in ultra-thin level. CN_x deposited at high N doping present higher sp^2 content due to the sp3 bond breakage and this tends to affect the film roughness. However, the roughness for all the CN_x films had smooth surface morphology with RMS less than 0.5 nm over an area of 1 μm^2.

(D) Corrosion study: Magnetic heads were deposited with 2 nm DLC and CN_x film (N_2 flow rate of 5, 10 sccm). The heads were put in 3 kinds of solution successively for corrosion. Firstly they were put into hot DI water for 1.5 hours, then were put into Na_2CO_3 solution for 10 minutes, finally were put into $FeCl_3$ solution for 4 minutes. After each step of corrosion, magneto-resistance (MR) values of the heads were measured by MR quasi-static measurement system. The sharp increasing or decreasing of MR value represents the corrosion of the head. For each group, there were 30 magnetic heads, by comparison of MR value change for each head, it can be observed that for the head group with DLC overcoat, the MR values for 5 heads increased dramatically after $FeCl_3$ corrosion, this means these heads were eroded. For the head group with CN_x film (N_2 flow rate of 5 sccm), the MR value increased for only one head, while for the head group with CN_x film (N_2 flow rate of 10 sccm), no MR value increasing was investigated for all the heads. This shows CN_x by FCA has good effect on the anti-corrosion properties of magnetic head.

REFERENCES

[1] J. Robertson, Thin solid films, vol. 383, pp. 81-88, 2001

[2] X. Shi, B. K. Tay, H. S. Tan, Z Li, Y. Q. Tu, J. Appl. Phys, vol. 79(9), pp. 7234-7240, 1996

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Large Magnetocaloric Effect in Several Perovskites, Intermetallic Compounds and Amorphous Ribbons

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Magnetocaloric effect is the heating or cooling of a magnetic material under varying magnetic field. To have large magnetic entropy change, ΔS_m, the materials must possess a high saturation magnetization and a sharp ferromagnetic-paramagnetic phase transition. For applications, materials need to have the phase transition at room temperature and low saturation field (the applied magnetic field required to saturate magnetization). This report presents our studies on large magnetocaloric effect of several materials: perovskites, 3d-4f intermetallic compounds, and amorphous ribbons based on Finemet. The materials can be considered as good magnetic refrigerants working for active magnetic cooling technique in a temperature range from low temperatures to several hundreds Celcius degrees.