질소 첨가된 ta-C 후막코팅의 기계 및 트라이볼로지적 특성연구
Effects of nitrogen doping on mechanical and tribological properties of thick tetrahedral amorphous carbon (ta-C) coatings

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초 록 : The effect of nitrogen doping on the mechanical and tribological performance of single-layer tetrahedral amorphous carbon (ta-C:N) coatings of up to 1 μm in thickness was investigated using a custom-made filtered cathode vacuum arc (FCVA). The results obtained revealed that the hardness of the coatings decreased from 65 ± 4.8 GPa to 25± 2.4 GPa with increasing nitrogen gas ratio, which indicates that nitrogen doping occurs through substitution in the sp^2 phase. Subsequent AES analysis showed that the N/C ratio in the ta-C:N thick-film coatings ranged from 0.03 to 0.29 and increased with the nitrogen flow rate. Variation in the G-peak positions and I(D)/I(G) ratio exhibit a similar trend.

It is concluded from these results that micron-thick ta-C:N films have the potential to be used in a wide range of functional coating applications in electronics. To achieve highly conductive and wear-resistant coatings in system components, the friction and wear performances of the coating were investigated. The tribological behavior of the coating was investigated by sliding an SUJ2 ball over the coating in a ball-on-disk tribo-meter. The experimental results revealed that doping using a high nitrogen gas flow rate improved the wear resistance of the coating, while a low flow rate of 0–10 sccm increased the coefficient of friction (CoF) and wear rate through the generation of hematite (α-Fe_2O_3) phases by tribo-chemical reaction.

However, the CoF and wear rate dramatically decreased when the nitrogen flow rate was increased to 30–40 sccm, due to the nitrogen inducing phase transformation that produced a graphite-like structure in the coating. The widths of the wear track and wear scar were also observed to decrease with increasing nitrogen flow rate. Moreover, the G-peaks of the wear scar around the SUJ2 ball on the worn surface increased with increasing nitrogen doping.