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Diamond-like carbon thin film deposition by filtered cathodic vacuum arc source for wear resistance improvement of zirconia toughened alumina

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Alumina has been used as engineering ceramic material widely due to high mechanical strength and hardness, wear and corrosion resistance. For higher strength and toughness, zirconia toughened alumina (ZTA) which has zirconia grains in alumina matrix has been used. However, ZTA has lower hardness and wear resistance than alumina. To improve the wear resistance of engineering ceramic, hard coating like diamond-like carbon (DLC) coating on ceramic surface has been used. In this study, tetrahedral amorphous carbon (ta-C) film which is the hardest DLC was deposited on ZTA by using filtered cathodic vacuum arc (FCVA) source and the wear resistance, hardness and scratch resistance was investigated according to the substrate bias conditions. The pulse bias was used for the substrate bias and the pulse frequency was 16 kHz and the rise time of the pulse was about 1 μ s. Because it was known that the hardness of ta-C thin film is related with the residual stress, the residual stress of the ta-C thin film deposited on dielectric material by FCVA source was investigated with various pulse voltages. The residual stress of ta-C thin film decreased monotonically with the substrate pulse bias. To obtain both high wear resistance and low residual stress, a bi-layer deposited with both high pulse voltage and low pulse voltage was deposited on ZTA. Through the pin-on-disk tests, the wear resistance was investigated in various thickness conditions of the ta-C bi-layer. It was found that the high residual stress layer has higher wear resistance. By using nano-scratch tester, it was found that the low residual stress layer has higher scratch resistance. The hardness and elastic modulus of ta-C thin film on ZTA was measured by using nano-indentation.

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