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Ultra-high-speed coating of DLC at over 100 $\mu\text{m}/\text{h}$ by using microwave-excited high-density near plasmaHiroyuki Kousaka¹, Yasuyuki Takaoka¹, Takashi Okamoto¹, Noritsugu Umehara¹¹Dept. Mech. Sci. Eng., Nagoya University, Nagoya, Japan

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Recently, with increasing demands for energy saving by friction reduction and lifetime extension by wear reduction, the application of DLC (Diamond-Like Carbon) to sliding surface of mechanical component is spreading steadily. In this field, higher-speed coating method with an applicability to 3-dimensional shapes is strongly desired, in order to expand the application range of DLC. Plasma CVD (Chemical Vapor Deposition) is a promising candidate for such demands due to its excellent capability to coat 3-dimensional shapes; however, the typical coating speed with conventional plasma CVDs is not high, $\sim 1 \mu\text{m}/\text{h}$; in addition, significant increase of the coating speed is not expected as long as low-density ($n_e \sim 10^8 - 10^{10} \text{ cm}^{-3}$) DC or RF plasma is employed. In order to break through the limit, the use of higher-density plasma is considered to be essential. Thus, in order to achieve an ultra-high-speed DLC coating with plasma CVD, we have proposed the use of a much higher-density plasma ($n_e \sim 10^{11} - 10^{13} \text{ cm}^{-3}$), which is sustained by microwave propagation along plasma-sheath interface on metal surface. In this work, it was demonstrated that DLC film with a hardness of 12 GPa was deposited at 188 $\mu\text{m}/\text{h}$ by using a newly proposed method. In order to make the hardness of DLC larger than 10 GPa, increasing the substrate current during deposition was effective.

Keywords

DLC

ultra-high-speed deposition

microwave

high-density plasma

plasma CVD