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Plasma-assisted lubrication for the sliding between polymer and DLC

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Diamond like carbon (DLC) has widespread applications in many fields because of its high hardness, low friction, chemical inertness, and other excellent properties. Recently, DLC is applied to machine parts as coating to reinforce the surface property. On the other hand, the use of polymer parts made of engineering plastics is increasing instead of metal ones because polymer is light, low cost and easily processed. It is expected in the future that the application of DLC to metal comes to be more frequent in order to further improve the sliding property between metal-polymer contact in sliding parts. For that reason, it is important to clarify the characteristic of friction between DLC and polymer. In this research, silicon doped DLC (a-C:H:Si), which is coated by plasma enhanced chemical vapor deposition (PECVD) on a steel disk (SUS304, JIS) 25 mm in diameter, was used as a mating material of sliding against Polyoxymethylene (POM) which is an engineering plastic. Friction tests were conducted in a roller-on-disk apparatus under dry condition, where the side surface of POM roller 5 mm in diameter and 5 mm in height was contacted to DLC-coated disk at a normal load of 1 N. Sliding test was conducted for 20 minutes at a rotation speed of 200 rpm, where the rotation radius of the roller changes from 5.5 to 10.5 mm along the roller axis. During the total sliding distance of 200 m, helium gas flow and helium plasma flow were irradiated for 50 to 100 m, and 100 to 150 m, respectively. Friction coefficient observed for the first 50 m without any irradiation was around 0.2, which was not changed by the following helium gas irradiation. Then, plasma irradiation caused seriously instable and high friction coefficient (around 1.0); however, after stopping the plasma irradiation, the friction coefficient rapidly fell down to around 0.066 and was stabilized. This result indicates the possibility of plasma-assisted lubrication for the sliding between polymer and DLC. (The authors gratefully acknowledge the funding by JST CREST, Japan.)

Keywords
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