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Corresponding author: ZHAO Jiang'ao
e-mail of corresponding author: zjabuaa@126.com
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Title

Tribological characteristics of CrN/DLC friction pair on cylinder block/valve plate interface in electrohydrostatic actuator pumps for aerospace

Authors

Yucheng LI [1,2], Dingchong, LV [1,2], Shoujun ZHAO[2,3], Jiang'ao ZHAO [1,2], Jian FU[1,2], Yongling FU [1,2]*

** Corresponding author*
[1] School of Mechanical Engineering and Automation, Beihang University,100191 BEIJING, China, zjabuaa@126.com
[2] Laboratory of Aerospace Servo Actuation and Transmission, CASC, 100176 BEIJING, China.
[3] Beijing Institute of Precision Mechatronics and Controls, 100176 BEIJING, China. shoujunzhao@vip.sina.com

Abstract

As a typical integrated fly-by-wire actuator, electrohydrostatic actuator (EHA) has been widely used in aviation, aerospace, ships, robots and other fields. Piston pump is one of the key power and control components of EHA. To achieve the demands of high power density and dynamic response position servo, EHA pumps are required to work in high frequency and wide range of speed/pressure. Due to this working condition, stable lubricating oil film can barely be formed, which brings great challenges to the lubrication/bearing of the friction pair, especially the cylinder block/valve plate interface. The traditional materials applied on it are the match of soft-on-hard, which have an inevitable issue of the severe wear on the soft material under the boundary lubrication/mixed friction state. Thus, the traditional match is not suitable for EHA pumps. Resent researches have indicated that applying proper hard coating is a promising way of preventing severe wear and improving friction characteristics under boundary lubrication/mixed friction state. In this study, DLC and CrN are coated on the surface of valve plate and cylinder block respectively, as a new type of hard coating pair. The friction-wear experiment is carried out through a specific test bench which can simulate the real working conditions of EHA pump. The tribological characteristics of the hard-on-hard coupling valve plate and cylinder block coated with DLC and CrN are obtained and analyzed. Results show that the hard-on-hard couplings with DLC and CrN coated materials can evidently improve the wear resistance of the cylinder block specimens, compared with traditional soft-on-hard materials (tin bronze). Additionally, the friction coefficient of the interface can basically maintain the same as the traditional materials, when the working speed reach 7000 r/min. As the speed continues to rise, the friction coefficient can decrease further. It can be concluded that in the state of boundary lubrication/mixed friction, applying hard coating with DLC and CrN can significantly improve the wear resistance and friction characteristics, and with the increase of speed, the friction coefficient can further decrease, compared with the traditional materials.

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