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滑油系统全流量在线磨粒静电监测技术研究

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Study of Oil System Oil-line Debris Electrostatic Monitoring Technology

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摘要

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摘要 针对滑油系统非金属材料难以实现在线监测的问题,基于静电感应原理展开全流量磨粒监测技术研究。研究润滑条件下荷电磨粒的产生机理和全流量磨粒静电监测原理,着重进行了静电信号特征提取方法研究。为验证磨粒静电监测技术的可行性,设计并搭建了模拟实验平台,开展了故障颗粒注入实验和循环润滑条件下销盘滑动摩擦磨损实验,使用自制的全流量在线磨粒静电传感器对油路中的磨粒进行监测。结果表明:静电传感器能够监测到金属、非金属等不同材料荷电磨粒;感应电压幅值与磨粒大小具有相关性;感应电压波形与荷电磨粒特性有关;静电传感器可以在线监测滑油回路中非金属摩擦副的摩擦磨损状态。

关键词: 航空发动机 滑油系统 全流量 荷电磨粒 静电 状态监测

Abstract: A new technology for oil-line debris detection based on electrostatic induction is developed for nonmetallic materials online monitoring of oil system in engine. The formation mechanism of charging debris and oil-line debris electrostatic monitoring principle in lubrication conditions are researched. The electrostatic signal feature extraction method is studied. Simulated experimental platform has been designed and developed to prove the feasibility of electrostatic monitoring technology. Two types of experiments are carried out. The first one is the injection of charged particles simulating the fault. The second is the sliding contact of friction and wear on modified pin-on-disc tribometer. A sensor with two ring-shaped probes is used to monitor the moving charged debris in insulation oil system. The results show that the oil-line debris electrostatic monitoring sensor can monitor the charged particles of various metallic and nonmetallic materials; inductive voltage is relevant to the debris size; shape of the inductive voltage is relevant to the debris charging characteristics; the sensor can online monitor the lubrication contact nonmetallic friction pair wear conditions.

Keywords: aero-engine oil system oil-line charging debris electrostatics condition monitoring

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