

谐振充电技术在火花开关触发系统中的应用

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Application of series resonant charging technology to trigger system for rotated spark switch

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摘要

为提高触发高功率横向激励大气压(TEA) CO₂激光器中旋转火花开关的稳定性和可靠性,减小火花开关触发系统的体积和重量,提出了将高频谐振充电技术应用于触发系统的方法。研发了采用全桥逆变结构和串联谐振软开关电路、输出电压大于38 kV、输出功率为2 kW的高频高压充电电源并将其作为旋转火花开关触发系统。该系统的全桥逆变电路由智能功率模块(IPM)构成,采用MSP430单片机控制IPM驱动信号的频率、脉宽以及个数,直流电压经全桥逆变电路及串联谐振电路在高压脉冲变压器原边获得脉冲信号。此脉冲信号经高压脉冲变压器的升压和变压器次级整流给高压电容充电,当电容电压达到火花开关间隙的自击穿电压时,电容放电。实验结果表明,该系统在500 Hz的重复频率下能连续稳定触发旋转火花开关,提高了触发系统的可靠性和稳定性,其体积及重量为脉冲式触发系统的1/2。

关键词 : TEA CO₂激光器, 旋转火花开关, 触发系统, 串联谐振, 充电电源

Abstract :

To improve the stability and reliability of the rotated spark switch system in a high power Transversely Excited Atmospheric(TEA) CO₂ laser and to reduce the volume and weight of a trigger system for the rotated spark switch, this paper induces the series resonant charging technology into the trigger system. A high-frequency high-voltage charging power supply consisting of a full bridge inverter circuit and a series resonant soft switch circuit is developed. The charging power supply is taken as a trigger system for the rotated spark switch and offers a output voltage greater than 38 kV and a output power of 2 kW. In this system, the full bridge inverter circuits consist of Intelligent Power Models(IPMs), and the MSP430 is used to control the frequency, pulse width and the number of pulses for IPM driving signals. After full-bridge inverter circuit and series-resonant circuit get the pulse signals, it will charge for a high voltage capacitor by increasing the voltage and rectifying for a high-voltage pulse transformer. When the voltage reaches the hold-voltage of spark switching, the capacitor discharges. The results suggest that the system can continuously and stably trigger the rotated spark switch when the Pulse Repetition Frequency(PRF) is 500 Hz. As a result, the system enhances the stability and reliability of triggering rotated spark switch and reduces the volume and weight of the system by 1/2 that of a pulse trigger system.

Key words : TEA CO₂ laser rotated spark switch trigger system series resonance charging power supply

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