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高电压技术

基于逆压电效应和模间干涉的电压互感器设计

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摘要

随着现代高压电力输送系统的发展，传统的电磁式和电容分压式互感器已暴露出越来越多的缺点。光学电压互感器具有体积小、重量轻、频带宽、动态范围大、抗电磁干扰以及良好的绝缘性等优点，已经得到人们的广泛重视。通过数值仿真，对椭圆芯保偏光纤模间干涉强度分布与模间相位差之间的关系进行计算分析并给出三维图，在此基础上设计了一种基于石英晶体逆压电效应和椭圆芯保偏光纤模间干涉原理实现的电压互感器。用有限元法对互感器传感头中的电场分布进行仿真计算，分析了金属电极的形状、尺寸等参数对传感头内电场分布的影响，对传感头进行了优化设计。通过试验对设计的电压互感器进行了可行性研究，表明基于该原理的电压互感器具有较好的精度和线性度。

关键词

电压互感器；模间干涉；逆压电效应；有限元法；电场分析

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Design of a High Voltage Transducer Based on Modular Interference and Converse Piezoelectric Effect

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Abstract

With the development of modern high-voltage power systems, more and more disadvantages in traditional electromagnetic voltage transformers and capacitive voltage divider voltage transformers are thoroughly exposed. Due to its advantages such as light in weight, wide frequency band, large dynamic range, resistant to electromagnetic interference and good insulation performance, the optical voltage transducer is paid special attention. By means of numerical simulation, the relation between interference intensity distribution pattern in elliptical-core polarization maintenance fiber (E-core PMF) and the modular phase difference is calculated and analyzed, and corresponding three-dimension plot is given. A voltage transducer based on converse piezoelectric effect of quartz crystal and the principle of modular interference of E-core PMF is designed. With finite element method, the electric field distribution in the sensor head of the transducer is simulated; the impacts of the parameters of metal electrodes such as their shape and size on electric field distribution inside the sensor head are analyzed, and the optimized design of sensor head is carried out. The feasibility of the designed voltage transducer is verified with experiments, and the results show that the voltage transducer based on the principle mentioned above possesses better accuracy and linearity.

Key words

voltage transformer；modular interference； converse piezoelectric effect；finite element method；electric field analysis

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