

基于布里渊散射原理的电缆分布式光纤测温技术研究

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摘要: 电缆的运行温度是评价电缆运行状态的关键因素, 传统的电缆测温方法主要采用热电偶、热电阻等传感器, 一般只能用于有限点的温度测量, 而基于布里渊散射的分布式光纤传感技术可在同一时间对电缆温度进行分布式测量。本文以在导体中央、屏蔽层外表面和阻水带中间植入了测温光缆的 110kV 交流电缆为研究试验对象, 用于验证电缆内置光纤测温的可行性, 并研究了热电偶和光纤的温度特性, 对比了热电偶传感测温 and 光纤测温的试验数据和结果。

关键词: 布里渊散射; 分布式; 测温; 试验

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Research on the cable distributed optical fiber temperature measuring technique based on Brillouin scattering principle.

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Abstract: The conductor temperature in cable operation is a key factor in the running condition assessment of cable, and traditional cable temperature monitoring method, using the thermocouple sensor to monitor the temperature of cable, can generally only be used for temperature measurement of finite points. The distributed optical fiber sensing technology based on Brillouin scattering can be used to distribute the temperature measuring of cable at the same time. In order to verify the feasibility of the built-in cable optical fiber temperature measurement, the AC cable in 110kV, of which the central split conductor, the external surface of the shielding layer and the water blocking were implanted with fiber, was used as the object in test. The temperature characteristics of thermocouple and optical fiber were studied, and the results of the two methods were compared.

Keywords: Brillouin scattering, distributed, temperature measuring, experiment

随着城市化规模的扩大, 城市地下电缆覆盖率越来越大, 如何对电缆运行状态进行准确的监测成为保证城市电网安全运行的重要课题。电缆的运行温度是评价电缆运行状态的关键因素。电缆载流过高, 电缆运行温度超过允许值, 会加速绝缘老化, 影响电缆寿命, 电缆载流过低, 又不能充分发挥电缆传输电能的能力, 造成资源浪费。传统的电缆测温方法主要采用热电偶、热电阻等传感器, 一般只

能用于有限点的温度测量。基于布里渊散射的分布式光纤测温技术用光纤作为传感器, 具有抗电磁干扰、适应恶劣环境、分布式长距离测量等优点, 具有广阔的应用前景。

1 布里渊散射的分布式光纤传感原理

由于光纤的非结晶材料在微观空间存在不均匀结构, 光在光纤内传播的过程中, 有一小部分光会发生散射。光纤中光的散射主要有三种: 瑞利散射 (Rayleigh scattering)、拉曼散射 (Raman scattering) 和布里渊散射 (Brillouin scattering), 如图 1-1 所示。