

高电压技术

应用频域介电谱法的变压器油纸绝缘老化状态评估

郝建, 廖瑞金, 杨丽君, 马志钦

输配电装备及系统安全与新技术国家重点实验室(重庆大学), 重庆市 沙坪坝区 400044

摘要:

通过频域介电谱法(frequency domain dielectric spectroscopy, FDS)测试分别在110℃和130℃下老化不同程度的变压器油纸绝缘试品的相对介电常数(ϵ_r)和介质损耗因数($\tan\delta$), 提出利用油纸绝缘试品在特征频率处的 ϵ_r 、 $\tan\delta$ 值评估油纸绝缘老化状态的新方法, 建立油纸绝缘试品在特征频率处的 ϵ_r 、 $\tan\delta$ 与绝缘纸老化状态的量化关系。结果表明FDS低频段对油纸绝缘老化状态反应敏感, 不同老化程度油纸绝缘试品在特征频率处的 ϵ_r 和 $\tan\delta$ 值与绝缘纸聚合度满足指数函数关系; 研究成果为将FDS用于无损诊断变压器老化状态提供参考。

关键词: 相对介电常数 介质损耗因数 频域介电谱 油纸绝缘 特征频率

Aging Status Assessment of Power Transformer Oil-Paper Insulation by Frequency-Domain Dielectric Spectroscopy

HAO Jian, LIAO Ruijin, YANG Lijun, MA Zhiqin

State Key Laboratory of Power Transmission Equipment & System Security and New Technology (Chongqing University), Shapingba District, Chongqing 400044, China

Abstract:

The relative dielectric constant ϵ_r and dielectric dissipation factor $\tan\delta$ of test specimens of power transformer oil-paper insulation with different degrees of aging under 110℃ and 130℃ are tested by frequency domain dielectric spectroscopy (FDS) respectively. A new method to assess the aging status of oil-paper insulation by values of ϵ_r and $\tan\delta$ of oil-paper insulation test specimens at characteristic frequency is proposed, and the quantitative relation of ϵ_r and $\tan\delta$ of oil-paper insulation test specimens at characteristic frequency with aging status of insulation paper is built. Test results show that at low frequency range the FDS is sensitive to aging status of insulation paper; the values of ϵ_r and $\tan\delta$ of oil-paper insulation test specimens with different aging statuses at characteristic frequency to the polymerization degree of insulation paper present the relationship of exponential function. The research results are available for reference to apply FDS to noninvasive diagnosis of transformer insulation aging status.

Keywords: relative dielectric constant dielectric dissipation factor frequency domain dielectric spectroscopy oil-paper insulation characteristic frequency

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通讯作者: 郝建

作者简介:

作者Email: cqhaojian@163.com

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