

主动屏蔽式平面探头水分在线传感器研究 Development of a Coplanar Electrode Capacitance Moisture Sensor

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关键词: 干燥 含水率 电容传感器 主动屏蔽

摘要: 设计了一种主动屏蔽的平面探头水分在线电容传感器。硬件方面设计了主动屏蔽式极板,从敏感区域聚集电场,减小了杂散电容对传感器测量精度的影响;平面探头及其传感器振荡电路避免了屏蔽极板对驱动极板的影响。有限元法分析表明,主动屏蔽极板的采用提高了传感器测量精度和灵敏度。软件方面由谷物含水率测量试验装置进行了一系列试验,实现了测试水分时温度自动补偿,其含水率测试的相对误差由传统传感器的5%降低到1%。鉴定结果表明,此谷物含水率传感器相对误差在 $\pm 1\%$ 范围内,含水率测量范围6%~36%,适用温度范围 $-10\sim 80^{\circ}\text{C}$ ,基本克服了传统国产电容水分传感器精度低、温度影响大、安装困难等缺点。A coplanar electrode capacitance online moisture sensor was developed, which has higher precision, more compact configuration and easier installation compared with traditional parallel electrodes and cylindrical moisture sensors. An active shield electrode was invented to block the outside electric field, thus the stray capacitance was decreased and the precision and sensitivity of the sensor was increased according to finite element analysis. A comparative circuit was used to avoid the influence of shield electrode on drive electrode. Experiments were conducted on grains with 6%~36% moisture content on a custom-built equipment. The relationships between sensor output frequency and grain moisture content were investigated for each temperature condition and the result was compiled into software to realize temperature compensation which decreased the error from 5% to 1%. Experimental validation proved that the sensor had a small measuring error of 1% and was applicable to moisture content range of 6%~36% and temperature range of  $-10\sim 80^{\circ}\text{C}$ .

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