Journal of Fiber Bioengineering and Informatics 8:1 (2015) 171–178
doi:10.3993/jfbi03201517

Research on Detecting Thickness of High Temperature Float Glass by Laser Trigonometry Measurement of CCD Sensor ⋆

.

Wei Wang*, Zhaoba Wang

School of Information and Communication Engineering, North University of China Taiyuan 030051, China

Abstract

It is very important to use the detection technology of float glass thickness in glass production. In the process of detecting glass thickness on line, we adopt laser trigonometry displacement detection theory. Directing at detection system theory in the high-temperature state, the paper does a further analysis. The paper analyzes the theory and experimental results by using the CDD detection method. The research improves the precision and stability of the detection, increases the glass production quality and cuts down the energy consumption and production cost.

Keywords: CCD; Trigonometry; High Temperature; Detection

1 Introduction

Generally, high temperature objects can show many different states, such as: solid state, liquid state, gaseous and plasma state. There are two kinds of methods to implement high temperature detection: one is Touch detection; the other is Un-touch detection. The former uses sensors to touch the detected object, whose method is characterized by high accuracy, easy operation and flexible use. But the location of detection is fixed, moreover, component of the sensor is easy to be destroyed. Therefore, the method causes an effect on the high temperature field. On the other hand, because the latter needn't touch the detected object, it doesn't destroy the temperature field of the object and can't ruin the component of the sensor. In view of these, the detection method causes less influence on production on line, so un-touch detection is a new trend of high temperature detection.

Glass thickness is not only a vital parameter in the process of glass manufacture, but also a crucial index in detecting quality of glass products. If the thickness of glass band is not stable,

⋆Project supported by Shanxi Provincial Young Science Foundation (No. 2013021015-2) and the National Nature Science Foundation of China (No. 60672005)

*Corresponding author.
Email address: 41695559@qq.com (Wei Wang).

it results in a lot of waste. However, we can detect the glass thickness in the hot side of the tinbath or annealing kiln, what's more, the research data can also be provided in time. In the way, time can be shortened and cost can be reduced and saved. Because environment temperature is about 600 °C in the hot side of annealing kiln, using the normal method to detect thickness is impossible.

2 Detecting Principle

The system employs Japanese Keyence LK-085CCD displacement sensor, which is a long-distance untouched displacement sensor and is acted as a light receiving component. Reflected lights from subject are focused on CCD through receiver lens group. The CCD determinates optical center by total optical distribution which enters light component. Moreover, it also adopts 32 super high-speed RISC processors to conduct signal processing. Then, take it as location of subject. However, because light distribution is influenced by surface condition of subject, it causes measurement errors. Its measurement reference distance is 80 mm, measurement range is 15 mm, light spot diameter of reference distance is 70 μm, resolving capability is 3 μm, sampling period is 1024 μs, analogy output is 5 V (3 mm/V), then displacement voltage by its controller LK-2110 can be obtained. Its principle picture is listed in Fig. 1.

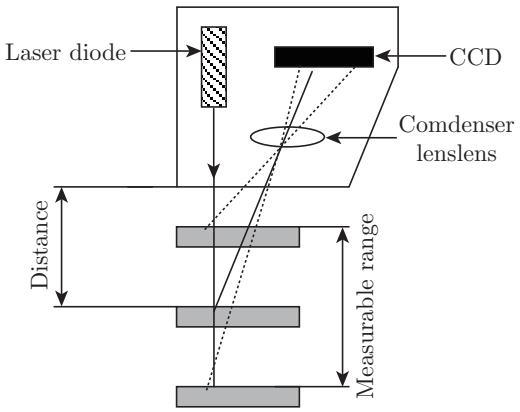

Fig. 1: CCD sensor measurement principle picture

Fig. 2 shows the signal waves which are formed on the surface of standard echo object (white paper) and 2 mm white glass by the laser trigonometry displacement sensor. The differentiating power of sensor is 5 μm when the system detects the standard object. It can show that the echo signal of the glass surface has low delicacy and high noise. Thus, the data need to be dealt with to meet the demand of the detection with a special method.

The research should be implemented to increase the signal amplified times and special signal disposal technique. So we meet the detection demand by means of sacrificing differentiating power (less than 20 μm).

In Fig. 3, it can display the detection project of glass thickness. We adopt two CCD laser displacement sensors, which are installed in the upside and downside of glass band to simultaneously detect the displacement of the upside surface and downside surface of glass band. We can calculate the glass thickness based on the displacement of the two sensors. In the practical process of production, float glass is passed on transferring roller. Inevitably, there exists jitter and