通过比较来学 - 学习写作

科技论文的写作，有一些人总是说是由于语言的问题造成的，实际上就是把它写成中文也是不过关的，这不是语言的问题，是文章的逻辑，其是啰嗦一会儿a、一会儿b，逻辑连贯性差，读下来很累。写作科技论文、检查自己软肋、纠正软肋的过程是比较痛苦的，有点肝颤，但是必须要过关的，很多人都已经过关了，你为什么不行呢？下面介绍一下方法 - 通过比较来学习写作。

下边的表格对比了发表之前和之后的文章比较，仔细读一下左边内容，再仔细读一下右边的内容。首先是发现出区别，“知耻而后勇”，首先要知道好歹，然后才能避免错误、纠正错误。学生最常见的问题是：“我觉得挺好好的呀”，但是编辑一看就发现问题，你觉得没有问题不重要、最重要的是他们决定文章的发表权，而不是你觉得没问题，如果编辑和老师都觉得有问题，你觉得没问题，那就是你有问题了：）“发现错误”这个过程是比较艰苦的，通过比较的方法比较有效。下边的表格对比左边内容与右边的内容，要仔细读、发现区别。有这么几个办法推荐给大家，一个是用手来抄写、用颜色笔去勾画。然后是分析这个区别：为什么之前写的有问题？仔细揣摩、琢磨、研磨，然后改正。

一共找了三个大的部分，引言，实验和结论，注意2个问题，一个是啰嗦、一个是逻辑链条。必要的话你把它用百度从中文看一看，你可以看到中文其实写的也不好，所以这不是语言的问题、这是作文的问题。嗯

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| 1 | th the rapid development of sensor technology, wired and active sensors are not suitable for some special occasions, especially when it comes to extremely high temperature measurement [1]. For example, researchers often need to measure the temperature of aero-engines. This measurement process is largely limited by the collection of sensors’ data. This problem also made it hard to achieve real-time internal information monitoring [2]. One of the effective solutions to this problem is the usage of surface acoustic wave sensors. Surface acoustic wave sensor is a new type of electronic device which has many advantages [3,4]. The most important application is SAW sensor with wireless sensing ability [5,6]. SAW-based sensors can wirelessly measure temperature without the usage of cables or additional energy [7]. For some applications that require indirect contact and high temperature measurement, wireless passive surface acoustic wave sensor may be the best choice [8]. Wireless communication can be achieved through SAW-based external antenna equipment so the effect of external connections on turbine blades will be reduced [9].At the same time, compared with traditional thermocouples, thermal resistance or other temperature sensors, surface acoustic wave temperature sensors have the advantages of smaller size and easier batch processing [10].  Various piezoelectric materials can be used as SAW substrates, such as lithium niobate, Langasite, and aluminum nitride. Lithium niobate (LiNbO3) has a high sound velocity, an excellent electromechanical coupling coefficient, and a high Curie temperature of 1140 °C [11]. It is a cheap material with piezoelectric, ferroelectric, optoelectronic, and thermoelectric properties [12]. LiNbO3 is widely used in surface acoustic wave devices, nonlinear optics, and optical communication modulators [13]. In order to reduce the difficulty of production and production process, this paper focuses on the surface acoustic wave velocity and electromechanical coupling coefficient while selecting piezoelectric materials. For the same interdigital transducer line width, the higher surface acoustic wave velocity, the higher resonance frequency of the device; the higher electromechanical coupling coefficient, the higher energy conversion utilization rate, and the lower the device design requirements [14]. Therefore, in order to pursue a larger and more linear temperature-frequency relationship, a 41°Y cut lithium niobate was selected as the piezoelectric substrate material.  Studies have shown that surface acoustic wave sensors with LiNbO3 substrate have been successfully operated below 400 °C [15]. However, due to the dehumidification and the recrystallization [16], simply growing a platinum electrode on lithium niobate substrate would cause measurement failures at a higher temperature. To ensure that piezoelectric substrate materials and electrodes can be stable at high temperatures, a passivation layer needs to be deposited on the surface of the SAW device for protection. A LiNbO3 surface acoustic wave sensor with SiO2 coating was designed in this paper, which has obvious advantages over the traditional SAW sensors.  The content of this article includes the design and manufacturing process of surface acoustic wave sensors with SiO2 coating. SiO2 passivation layer covers the upper layer of lithium niobate and platinum electrodes to protect them from high temperatures. This article shows the results of S11 measurement and temperature measurement of SAW from room temperature to 1100 °C. Meanwhile, since the operating temperature of aviation turbines is between 800 °C and 1100 °C, it is truly necessary to enable SAW to measure such a high temperature.  In this paper, a SiO2 passivated SAW sensor containing a 41°Y LiNbO3 piezoelectric substrate, platinum (Pt) interdigital fingers (IDTs) and platinum (Pt) electrodes was manufactured. It can detect 1100 °C and has good repeatability and durability, which makes a huge breakthrough. | ith the growing demands for advantageous sensor technology, traditional wired and active sensors may become inadequate for some special occasions, especially when it comes to extremely high temperature measurement[[[1]](#endnote-1)]. For example, it is often required to measure the temperature of aero-engines' working parts, but this process is, to a large extent, limited by the output feasibility of sensing signals[[[2]](#endnote-2)]. Wireless and real-time sensing is necessary [[[3]](#endnote-3),[[4]](#endnote-4)] in this scenario and one of the effective methods is to use surface acoustic wave sensors (SAW)[[[5]](#endnote-5),[[6]](#endnote-6)]. A SAW-based passive wireless sensor is capable of measuring temperature without using extension cable / external power supply[[[7]](#endnote-7)], very suitable for the cases where the wired connection is difficult such as in jet engines with both high temperature and high pressure ambient[[[8]](#endnote-8),[[9]](#endnote-9)]. Compared to the traditional sensors such as RCL sensor [[[10]](#endnote-10),[[11]](#endnote-11)], a SAW sensor is also small in size and can be built in batch using MEMS micro fabrication technique[[[12]](#endnote-12)] on piezoelectric substrate. There are quite a few piezoelectric materials can be used as the SAW substrate, such as lithium niobate (LN)[[[13]](#endnote-13)-[[14]](#endnote-14)], Langasite (LGS)[[[15]](#endnote-15),[[16]](#endnote-16)], and more advanced super-high temperature piezoelectric materials[[[17]](#endnote-17),[[18]](#endnote-18)]. Among them, LiNbO3 is a matured commercialized material with good piezoelectric, ferroelectric, optoelectronic, and thermoelectric properties[[[19]](#endnote-19)], while the others are expensive or still in developing stage. LN’s Curie temperature is as high as 1140 °C [11], suitable for most situations in aero-engine system (~1000oC). Yet previous studies have shown that SAW sensors with LiNbO3 substrate cannot operate at temperatures higher than 400 °C [[[20]](#endnote-20)] due to dehumidification and recrystallization[[[21]](#endnote-21)].  In this paper, this bottleneck has been broken with a SiO2 passivation layer on the SAW device, which protects the piezoelectricsubstrate and the IDT electrodes. This article describes the design and manufacturing process of this high-temperature-tolerance SAW sensors and the SiO2 passivation technique, together with the high-temperature RF verification test using these SAW devices. The SAW sensor is capable of measuring the temperature up to 1100 °C with good repeatability and durability, which is quite a great breakthrough. High-temperature sensing in the range of 800 °C to 1100 °C has a special significance for the aero-engine R&D [[[22]](#endnote-22)], since the tolerance of most turbine metallic alloy is no more than 950 °C. The active operation temperature of turbine blade can be just measured using our cost-effective LiNbO3-based wireless passive sensor. For higher temperature, new piezoelectric material of SAW sensors [[[23]](#endnote-23),[[24]](#endnote-24)] shall be considered and our method can still serve as a good reference point to build new devices. |
| 2 | High temperature cycle experiment In order to verify the stability of device measurement, this SAW was sent for a high temperature cycle test after the 1100℃ experiment (phase 1). The SAW sensor was cooled from 1100℃ to 800℃ (phase 2), then warmed up to 1100℃ again (phase 3) and cooled down naturally (phase 4) at last. The results are shown in Fig.5. The values of a thermocouple voltage were collected in high temperature cycle experiment for measuring the real-time temperature, which were only used for device testing, not for SAW formal measurement.  The black polyline shown in Fig.5(a) is the change of resonance frequency, and the red polyline is the change of temperature. It can be seen that there is a good correspondence between them two. As the temperature rises, the resonance frequency of the surface acoustic wave sensor decreases; and as the temperature decreases, the resonance frequency increases. All the results have a good sensitivity.  Combining the data obtained from 1100 °C experiment with high-temperature cycle data in Fig.5(b), we can see that the resonant frequency of surface acoustic wave sensor has outstanding linearity and repeatability. The initial experimental data agree well with high-temperature cycle data, and the linearity is consistent. It shows that the surface acoustic wave sensor fabricated in this paper has good repeatability and can measure temperature for multiple times.  A good linearity and repetitive results of resonant frequency vs. temperature relationship up to 1100 ℃ were observed with a relative error below 0.1% in this temperature cycling and 5-hour endurance test. | High temperature cycle experiment and endurance test A temperature cycle test was performed to verify the sensor repeatability by over 5-hours’ temperature cycling following the pattern shown in Fig.5 (a): from room temperature to 1100 ℃ (phase 1), from 1100 ℃ to 800 ℃ (phase 2), then ramping up to 1100 ℃ again (phase 3) and eventually cooled down naturally (phase 4). The sensor’s performance is shown in Fig.5 (b). Good linearity and repetition of resonant frequency vs. temperature relationship from 800 to 1100 ℃ are observed with a relative error less than 0.1%.  The same SAW sensor was tested afterward in 800 ℃ for 3 hours while the SAW sensor’s performance still remains stable, indicating that the passivated SAW sensor also has a fairly good endurance (≮ 8 hours when temperature ∈ 800-1100 ℃). |
| 3 | Conclusions In this paper, a lithium niobite surface acoustic wave sensor that can work consistently at high temperatures was designed and manufactured by using MEMS process. By adding a SiO2 passivation protective coating, the piezoelectric quality of LiNbO3 and surface electrode are protected from damage. This crafting process makes SAW device able to work at temperatures between 20°C and 1100°C with good repeatability.  A high-temperature measurement was performed in this paper on the SAW sensor using a direct-connected coaxial network analyzer. The SAW sensor has an outstanding temperature-frequency coefficient of -15.12KHz/°C. At the same time, the repeatability and continuous working ability of the same SAW sensor at high temperatures were tested through high temperature cycle experiments and high temperature maintenance experiments. Fully showed that the SiO2 passivation scheme used in this paper has good protection for surface acoustic wave device, so its upper temperature limit is increased from 400°C to 1100°C.  When the temperature exceeds 1100 °C, the piezoelectric properties of lithium niobate base material decrease, so the peak return loss gets smaller significantly and the noise is aggravated, which lead to the resonance frequency changing turbulently until the device is damaged by reaching the melting point of the base material. Therefore, the upper temperature limit of surface acoustic wave sensor based on lithium niobate should be set to 1100 °C. Experiments show that the device cannot work properly when the temperature is between 1100 °C to 1150 °C, but the temperature-frequency relationship can still be restored after the temperature reduces. | Conclusions In this paper, lithium niobite SAW sensor with a SiO2 passivation was successfully built with MEMS process. The sensor is capable of measuring temperature up to 1100°C with good repeatability and high-temperature endurance no less than 8 hours above 800C, accredited to passivation protection of silicon dioxide film to cover the LiNbO3 substrate and IDTs of the SAW device. The SAW sensor has a good temperature-frequency coefficient of -15.12 KHz/°C. When the temperature exceeds 1100 °C, the piezoelectric quality of lithium niobate is lost and the SAW sensor stops working, but it restores sensing when temperature drops down below the Curie temperature of LiNbO3. It is anticipated that with a high-temperature tolerant near-field antenna attached to the SAW sensor, long-range wireless passive high-temperature remote sensing will become possible in our future continuous endeavor. |

1. References

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