Impact on the voltage amplitude on Microquality detection of QCM

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Abstract. The core of environmental pollution detection is quartz crystal microbalance and data acquisition circuit. Under certain conditions, when the quartz crystal vibration surface adsorbs other substances, the natural frequency of quartz crystal vibration changes with the size of adsorption mass, and the frequency is converted into identifiable micro-mass data through the data acquisition circuit. This project USES quartz crystal to detect environmental pollution.

Keywords: voltage amplitude; microquality detection; QCM; oscillation circuit; signal conversion.

1. Introduction
AT - cut crystals have the maximum frequency offset in the -30-80°C range when the tangent Angle deviation is 0°. AT-cut quartz crystal is widely used in sensing technology [1, 2]. For high-quality AT-cut resonators, the daily aging rate is up to, and the short-stability in seconds is better than that in seconds. In addition to the advantages of wide frequency range, high piezoelectric activity and convenient wafer processing, the AT tangent type has zero temperature coefficient point in the atmospheric ambient temperature range [3]. Therefore, the resonance frequency stability in the wide temperature range makes it suitable for the QCM sensing technology [4].
The oscillation frequency of BT cut resonator is a quadratic function of temperature [5, 6]. The frequency constant of a BT cut resonator is 50% greater than that of an AT cut, so it is about half as thick when the frequency is constant. The biggest advantage of BT cut resonators is that they have a high Q value. The Q value of BT cut resonators with three overtones is more than three million, while the Q value of AT cut resonators with three overtones is only about two million [7, 8]. The disadvantage of BT cut resonators is that their frequency-temperature characteristics are worse than AT cut, that is, they are greatly affected by the environment and are not suitable for outdoor applications [9].

2. Experimental Details
The classification of quartz crystal is mainly based on the difference of natural frequency of quartz chip and the difference of electrode material. The research and design: quartz crystal fixture reference data and the project requirements, design a set of reasonable quartz crystal fixture, solve the jig edge effect caused by quartz crystal (makes shear vibration cannot be focused on the electrode area [10], undermining trap effect), and as far as possible, yes light fixture structure is simple, easy to maintain, low cost and with a constant temperature device.

Electrochemical impedance experiments and dynamic polarization were studied by using PARSTAT 2273 Advanced Electrochemical System (USA) at the open circuit potential.

When selecting the appropriate type of quartz crystal, the supporting circuit should be considered, and through improvement, the data acquisition circuit that meets the requirements of the project should be designed.

3. Results and Discussion

3.1. Different electrode contamination tests
AT-cut quartz crystal is still affected by temperature, humidity and other external factors, so how to avoid environmental factors should be considered in the design process. The jig of quartz crystal should
be easy to disassemble and replace QCM quartz crystal. The casing of the drive circuit and Au/D conversion circuit is made of aluminum alloy and sealed with glue to prevent water damage to the circuit.

(1) 6M. A-C electrode

![Fig. 3 A-C 6M electrode diatomite test.](image)

(2) 6M. Q-C electrode

![Fig. 4 6M Q-C electrode diatomite test.](image)

(3) 8M. C-Si electrode

![Fig. 5 C-Si 8M electrode diatomite test.](image)

(4) 8M. C-T electrode

![Fig. 6 C-T 8M electrode diatomite test.](image)

(5) 9M. A-A electrode
3.2. Different contamination tests for the same electrode

AT-cut quartz crystal is still affected by temperature, humidity and other external factors, so how to avoid environmental factors should be considered in the design process. QCM quartz crystal fixture should be easy to remove and replace QCM quartz crystal. The casing of the drive circuit and A/D converter circuit is made of aluminum alloy and sealed with glue to prevent water damage to the circuit.

(1) 8M. C-Si electrode

(2)

(3)

(4)
Tilt the quartz crystal at different angles to see if the angle affects the test. During the test, you can use a hair dryer to blow the contamination into the glass box, so that the contamination evenly falls on the quartz crystal, read the output data and record, and then collect the contamination on the quartz crystal for weighing.

4. Conclusion
By means of dropping, spraying, coating and drying sewage, the dust object has different adhesion effect on the surface of quartz crystal. After one set of measurements is made, the quartz crystal is cleaned of any contamination that might otherwise interfere with the next set of measurements. Quartz crystal should be cleaned by ultrasonic wave to avoid damage to quartz crystal. Analyze the natural conditions,
consider the impact of various weather on quartz crystal, simulate various weather for experiments, and observe the output data changes in the whole process.

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