A New Type of Measuring Instrument for Shear Modulus of Elasticity

Wei-min PAN, Lei ZHANG and Meng-han LI
School of Mechatronics Engineering; Henan University of Science and Technology,
Luoyang 471003, China

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Abstract. In order to determine the shearing properties of material accurately, a new instrument for shear force was developed. In the Measuring Instrument, the linear motor was used as driving mechanism, the force sensor was used to collect the shear force of material, meanwhile displacement was measured by the transducer, and then the stress was calculated by computer. And the relationship of stress and strain relation was got. The design of clamping mechanism was optimized, which avoided the slip phenomenon. So the measurement error is reduced greatly.

Introduction

With the rapid development of industrial technology, the application of material is becoming more and more extensively. Such as, communication, chemical, aerospace, medical equipment, daily product and so on. Its excellent characteristics may play an important role in improving the overall performance. Usually the method of materials are measured by including: nano-indentation method, tympanic membrane method, micro bridge method, resonance method, cantilever beam method, the micro structure method, micro stretching method and micro reverse method, etc.[1] According to experimental conditions, this is the use of micro-stretching method, it can directly access to the detection of stress and strain relation.

At present, the scholars of home and abroad have carried out a series of studies. Experimental device of David T. Read was stretched that the piezoelectric actuator provided tension, the elastic beam was used as force sensor and the displacement was measured by eddy current sensor [2]. The test device of W. N. sharp was stretched by the piezoelectric ceramics and air static pressure bearing. The strain was measured by strain gage method, the force sensor collected signal and dovetail groove mechanism was used as the clamping mechanism [3]. As well as professor Taihua Zhang, uniaxial tension has been a series of achievements in China.

We use and improve the uniaxial tension to make the clamping mechanism become more firmly, under the action of the sensor, the force and displacement are measured, in order to test the relationship of stress and strain. The design will greatly reduce the slip phenomenon and the measurement error. In addition, the reasonable mechanical bracket design will make the operation become extremely convenient.

Principle

Experiment device should be required high degree of stability and appropriate measuring accuracy. For the test of tensile properties, force and displacement detection also should be equipped data acquisition and analysis. In the design, the force sensor was used to test the shearing force of the materials, meanwhile displacement was measured by the transducer. The information of collection was treated with the information acquisition device. Force sensor and transducer should be ensured the accuracy of data, meanwhile clamping device also should be ensured the convenience and stability of clamping, in order to avoid slip phenomenon in the drawing process. Principle diagram is shown in Figure 1.
As research on complex products continues to grow, interest has arisen in measuring the elastic properties of materials. Shear modulus terms are used in calculations of shear deflection, torsion, lateral buckling, and fracture mechanics. Currently, there is no single test standard for the shear modulus determination of SCL materials. A test method for the determination of the shear modulus and the modulus of elasticity of composite materials is presented. By measuring the normal deflections corresponding to the applied loads, shear modulus and modulus of elasticity of the ring
can be determined from the formulas. The assembly framework of the measuring instrument is shown in Figure 2 and Figure 3. The main device is composed of 5 components: mechanical support, fixture, force measurement, displacement measurement, drive unit and so on [4]. In the instrument, the force is detected by the resistive force sensor, the displacement is measured by the transducer, and they take the connection mode of coupling, which could ensure material force and displacement measured at the same time, reduce the error on the stress and strain curve drawing. Transducer is connected by the screw of variable length and the below shear machine. Shearing mechanism is adopted reasonable design, which would play a role in reinforcement of specimen.

**Design of Clamping Mechanism**

Design of shearing mechanism for instrument, which should be ensured stability of the clamping mechanism, prevented because of loose, so produced a large number of error, and made sure instrument can effectively transfer the shear force.

This design adopts the three gaskets, 3 clamping collar, the material putted in the middle of gaskets and strengthened by the screw, The left and right clamping collars are fixed to remove the screws, and the middle clamping sleeve is used for clamping the middle clamping pad. 3D Model of Clamping Mechanism is showed as Figure 4.

![Figure 4. 3D Model of Clamping Mechanism.](image)

The purpose of this design, which to prevent material that happened the slip phenomenon in the process of stretching, this is the material and gaskets sliding. The double layer reinforcement device ensures the stability and accuracy of the shear mechanism. Clamping Mechanism is showed as figure 5 and three clamping blocks are showed as figure 6.

![Figure 5. Clamping Mechanism.](image)  ![Figure 6. Clamping Blocks.](image)
Summary

(1) A new type of shear force tester is designed to measure the relationship between stress and strain.
(2) The characteristic of the instrument is the connection of the cross-linking of the force transducer and transducer, which greatly reduces the error of the measurement.
(3) Using the ingenious design, the clamping mechanism of the shear force tester is strengthened, and the sliding problem is solved to a great extent, which improves the accuracy of the measurement.
(4) The instrument uses a special support, which provides a great convenience for the operation of the test process and the maintenance of the instrument.

References