Research on the Flow Stress of Thermal Compression Deformation of 5052 Aluminum Alloy Based on Computer

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Abstract. The design of 5052 aluminum alloy products is inseparable from the application of hot compression deformation technology, a considerable part of automotive aluminum alloy parts are composed of complex spatial curved surface rheological stress. CATIA thermal compression deformation technology in the design process not only to meet the structural characteristics of the parts, but also to ensure the smoothness, wear resistance of the product, so as to apply 5052 aluminum alloy products in a more comprehensive and effective application, and promote the design of automotive aluminum alloy more perfect, improve the efficiency of automotive aluminum alloy development.

Keywords: Catia Surface Flow Stress, Modelling Technology, 5052 Aluminium Alloy Products, The Design Process

1. Introduction
CATIA hot compression deformation technology is large CAD drawing application software developed by French Assault Company, and then it is widely used in IBM work sites[1-3]. Most of the corresponding aluminum alloy drive systems of automobiles are CMS braking. Meanwhile, compared with UG, CATIA thermal compression deformation technology can more perfectly display the thermal compression deformation advantages of contemporary 5052 aluminum alloy product design, which is widely used in aerospace, automotive aluminum alloy and other series of curved surface rheological stress design[4-6].

2. Principle and method of thermal compression deformation of CATIA

2.1. Principle of hot compression deformation
The flow stress of any curved surface in space can be regarded as a collection of points. As shown in Figure 1 below, M+1 point can be selected as rheological stress points of the characteristic surface on the interface formed from the V direction from left to right. The curve of B-spline can be obtained by using the least square method for infinite approximation of the curve. Similarly; N+1 points are selected as the corresponding rheological stress points of the characteristic surface on the interface formed from top to bottom from the direction of U to form the B-spline curve of its interface. The
rheological stress of the surface formed by the interlacing of the two points is the complex surface rheological stress constructed by CATIA.

![Figure 1. Surface rheological stress configuration of double-coordinate B-spline.](image)

In Figure 1, if there are more feature points in the B-spline curve, more spline curves will naturally grow, and the curved surface rheological stress grid formed will be more and more similar to the actual curved surface rheological stress. CATIA thermal compression deformation describes the regular or complex curved surface rheological stress space with such a mathematical model.

On the other hand, foreign automobile aluminum alloy industry started earlier, in the 1970s, someone began to use CAD/CAE auxiliary design tools for product design research. Through design optimization, reliability expansion and computer simulation technology to shorten the product development cycle, improve the quality of products at the same time to optimize the overall performance of automotive aluminum alloy, and reduce the cost of development, automotive aluminum alloy traditional design methods gradually out of the stage of history. 2004 scholars Choi J H is the limited element method is adopted to improve the friction heating disc brake contact problem of transient analysis, and further to explore the behavior of related material and thermoelastic effect, and on the basis of existing size, determine and modify the corresponding equipment, through the technological means for the direct metal laser groove on the surface of the plate overall heat dissipation, further enhance the applicability of the hot compressive deformation technology.

2.2. Main thermal compression deformation methods of CATIA
The thermal compression deformation techniques of CATIA include regular surface flow stress and complex surface flow stress. The former consists of a series of regular curved surface rheological stresses such as sphere, tube surface and cylinder surface, which can be formed by three-dimensional rotation and stretching of the figure. It is relatively simple. The latter is the contemporary 5052 aluminum alloy product design important difficulty. Using CATIA thermal compression deformation technology, a series of surface rheological stresses such as SURF2, PATCH and NET can be constructed for complex surface rheological stresses, which mainly include scanning, cross section driving, connection, filling, mesh, rule description and Boolean operation.

3. Design process of hot compression deformation
Next, the author will explore the application of CATIA thermal compression deformation technology in contemporary 5052 aluminum alloy product design on the basis of automotive aluminum alloy brake system and disc brake thermal compression deformation.

3.1. Part analysis and surface rheological stress decomposition
The brake disc of automobile aluminum alloy is usually a disc-based working end face with corresponding circular holes on the surface, which can reduce the weight and effectively increase the
friction force for practical use. The flow stress of the overall surface of each component can be divided into two types: the flow stress of the basic surface and the flow stress of the transition surface. Disc brake is an important rotating element in the brake system, which is classified by the fixed structure, generally including the whole brake and the clamp brake. The former is optimized by the disk-shaped metal back plate and the friction design, and can be in full working face contact with the brake disc, including four basic surface rheological stresses. Clamp type friction slices through the contact with the brake disc corresponding working face, to form a disk brake of the whole braking options, and different brake blocks made of different work contact area, and the corresponding and actuating device can be installed across the clip-on hanger on either side of the brake disc, called brake pliers, including one to four basic surface rheological stress and surface rheological stress.

3.2. Surface flow stress design and quality evaluation

From the perspective of curved surface flow stress design, the design of fixed pliers disc brakes is usually made in different directions according to the axle, so as to ensure that the corresponding brake shoes fixed on the axle cannot rotate at will (as shown in Figure 2 below).

![Figure 2. Detail of thermal compression deformation of a fixed clamp disc brake.](image)

It is an important process of axial brake disc product design to construct "ridge line" and select reasonable brake disc based on CATIA thermal compression deformation technology, which is also divided into swing plate brake disc and swash plate brake disc. Different brake discs are applied in different work categories. But from the overall point of view, the spindle can effectively drive the rotation of the drive plate, and pressure the center of the Mosaic plate to move. This causes friction between the production plate and the plate roll, but such shortcomings also lead to the pliers disc brake has been difficult to meet the needs of the current era, gradually eliminated.

3.3. Combination of flow stress of integral structure and curved surface

Based on national standard of the audi A4L5052 aluminum alloy products design, surface rheological stress design, the arrangement of the front brake disc as close to the tyres, brake disc and the design measure and longitudinal beam welding way should be adopted when the brake disc for manual welding, the U bolt connection is used to connect car aluminum alloy brake disc and the thrust connection plate, the most suitable in 1.6 kg/cm², 3.5 kg/cm² Select within the scope. The thickness of the brake disc and brake quality has the close relation, if the thickness of the brake disc in the surface rheological stress and reality changes have taken place, it is likely to lead to change the size of the flow stress surface, because of the stress concentration effect will lead to different kinds of frame girder has the uneven situation, and the thickness is too small, and lowering the temperature rise of the brake work yes. Brake disc can effectively solve the situation of ventilation and heat dissipation.
In addition, the thermal compression deformation of CATIA should also consider the brake clearance adjustment and the size and quality of the brake, which plays an important role in the flow stress combination and overall structure of the curved surface. According to experience, brake clearance adjustment is a relatively frequent aluminum alloy maintenance work. Therefore, in order to make the debugging work convenient, the structure form and installation position of the debugging device should be conducive to the smooth adjustment work. At the same time, the automatic adjustment function of the brake makes it unnecessary to check and adjust it frequently. At the same time, with the increase of the speed of aluminum alloy in modern cars, considering the stability of aluminum alloy in cars, smaller tire size is usually chosen. However, the smaller the size of the tire, the smaller the flow stress of the corresponding design surface, the greater the brake torque required during braking, and the larger the diameter of the brake drum (brake disc) determined by the brake torque. In order to make the brake drum (brake disc) will not be too large in diameter, and cannot be installed on the hub, so it is necessary to choose a small size, high efficiency brake type. In order to improve the ride comfort of automobile aluminum alloy, the quality of wheel brake should be reduced as much as possible.

4. Application of modelling technology for flow stress of complex curved surfaces

4.1. Construction method of CATIA thermal compression deformation in 5052 aluminum alloy product design

Using CATIA hot compressive deformation technology analysis found that the effective radius of brake disc and the brake pliers clamping force is inversely proportional to, and the brake disc is located in a cradle, will be fixed on the vehicle, car chassis is the basis of the main assembly and special equipment installation work, the biggest impact is a special of the major parts material and keep the basic material strength and stiffness, in principle, the main parts are not allowed to the hole and welding, the installation of special equipment and other auxiliary components, need to drill a hole in the frame or welding. We need to avoid drilling and welding in high stress areas. The upper stress region of the main frame beam is located between the bottom and the suspension beam between the axis. These areas are concentrated voltages caused by longitudinal beams of light that are easily generated from drilling. Because the longitudinal beam stress is large, it is easy to cause stress concentration, so it is necessary to further select the corresponding surface rheological stress coefficient.

4.2. The flow stress of Boolean operation surface is used to design the exhaust manifold of automobile aluminum alloy

The application of CATIA complex thermal compression deformation technology in the design of 5052 aluminum alloy products requires a series of steps, such as part analysis, surface rheological stress decomposition, surface rheological stress design, surface rheological stress combination, surface rheological stress quality evaluation and so on. There are two types of automobile aluminum alloy exhaust manifold: integral manifold and combined manifold. These two types have their own advantages. The former is simple in overall construction and relatively cheap in price. The mass of the former is lighter when the stiffness is the same, and the integral exhaust manifold is more suitable when the same condition is used for a long time. First of all, the combined exhaust manifold is easy to replace connected parts, suitable for a variety of working conditions, need to transfer to other more convenient, because easy to disassemble. This design adopts the integral exhaust manifold, based on the flow stress of Boolean operation surface, and the exhaust manifold arrangement is the lower form. The second is to design the arrangement of air pipes and cylinders. There are two kinds of trachea: divided and combined. Since there is no regulation of the length of the trachea in this design, it is also designed as an integral trachea, and the trachea is placed above the trachea.

The third is to determine the length ratio of the exhaust manifold to the trachea. In this design, exhaust manifold and the length of the trachea ratio should provide enough force for servo when
transported, the design process, also can't more than needed, in order to avoid wasteful, general now the trachea and the proportion of the exhaust manifold in middle scheme selection, usually there are three kinds of schemes, one is a long arm short tube, long tube is a short arm, another middle rate. The length ratio of these three is different, so will the air discharge. This time, the design adopts the intermediate ratio scheme.

5. Conclusion
The thermal compression deformation techniques of CATIA include regular surface flow stress and complex surface flow stress. Using CATIA hot compressive deformation technology can be used in a scanning, section driver, connection, filling, grid, rule description and Boolean operation of this a few kinds of surface flow stress structure, implementation parts in 5052 aluminum alloy products design analysis, design of surface flow stress decomposition and surface flow stress of surface, flow stress combination of surface flow stress quality evaluation and a series of steps, in the contemporary plays an important role in the design of 5052 aluminum alloy products.

Acknowledgments
Supported by the 2020 guangxi university middle-aged and young teachers' basic research ability improvement project (Project number 2020KY57009).

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