MECHANICAL PROPERTY OF METAL RUBBER PARTICLES FOR AN AUXETIC STRUCTURAL DAMPER

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Key words: Metal Rubber, Metal Particle Balls, Nonlinear Stiffness, Damping, Auxetic structure

Abstract: Metal Rubber (MR) is a porous damping materials, it is made of wires through choiceness, encircling, wiredrawing, weaving and molding by compression. The term Metal Rubber arises from the similarity between the properties of metal and rubber. It has the following characteristics: 1) High elasticity, 2) High damping, 3) Light weight, 4) zero-passion rate, 5) Strong environmental adaptability, 6) Controlled porosity, 7) Easy-to-shape, 8) Good thermal mechanical performance. Thus MR can be widely used in many aspects such as damping, sound absorption, seal and thermal protection as shown in Fig.1.

In order to enhance the performance of engine, many components are designed as hollow structures. But these components are also subject high loads. Some of the loads may lead to the high cycle fatigue of components. A new MR component is designed by improving the processing technology. It is called Metal Rubber Particles (MRP). MRP makes up small metal particle balls which made by a piece of spiral wire. The diameter of balls is about the 4~5mm as shown in Fig.2. MRP have some additional advantages of light quality and good structural adaptability. MRP can match various complex shape of cavity to reduce the vibration level of structure, such as the blade and case for the engines. Because of the low relative density, MRP can introduce less additional weight and almost not affect the performance of engine. Therefore, it is necessary to do some research on the performance of MRP and the application...
in hollow structures.

Fig.2 Metal Rubber Particles

The article mainly aims at the static and dynamic performance of MRP. The WDW3100 electronic universal testing equipment was used to obtain the static characteristics of MRP during static experiments. The static stiffness and loss factor of MRP are obtained by measuring the static hysteresis curve. The dynamic experiments of MRP, which can test the response-frequency curve of the vibration system with MRP dampers subjected by dynamic loads, were conducted and the damping ratio could also be obtained. The influencing laws of material parameters and process parameters on mechanical property of MRP were obtained by measuring the static and dynamic performance of MRP with different relative density, different wire’s diameter, different spiral wire’s diameter, different pre-compression, different placing density and different filling position. By the experimental results of MRP, the advantages and disadvantages were summarized. And the design rules of MRP were also concluded from the static and dynamic experiments in order to get good performance. With these researches, it will increase the further application prospects of MR and provide a new approach to vibration control technology of the complex structural design for the engine. We propose also the design of an integrated auxetic composite panel damper using a chiral topology, where the truss-core structure is made of central cylinders connected by tangent ligaments. The cylinders can be used to host the MR particles and provide an embedded distributed damping systems for high-end sandwich panels subjected to high-cycle fatigue and nonlinear dynamic loading. We provide an assessment of the integrated auxetic MR damper concept, with feasibility given by a combination of modal analysis and forced response techniques on this innovative damping panel.

Figure 3. (a) Tetrachiral auxetic truss core; (b) MR particles embedded in the cylinders (c)