EXPERIMENTAL MODAL ANALYSIS ON Al6061-Cu BIMETALLIC SIMPLY SUPPORTED BEAM

K.Arun,

Department of Mechanical Engineering, University college of Engineering Viilupuram. Villupuram

Abstract : Dissimilar metals can be manufactured in diffusion bonding method, it is used to the construction work. The proper strength of the bond between the core and the cladding layer like Al 6061-Cu bimetallic shaft. This particular material having mechanical properties like durability ,rigidity, Low weight, High corrosion resistance and good mechanical properties. The objectives of this paper is to find out modal characteristics of above materials.This type of analysis is typically used for the design and optimization of a system far too complex to analyze by hand.

Keywords: Dissimilar,Modal analysis

INTRODUCTION

Al6061−Cu bimetallic joint materials have their advantages due to their excellent properties combining low density, lightweight, corrosion resistance of aluminum, with high level of electrical and thermal conductivity of copper[1]. Diffusion bonding is a solid state metal joining diffusion process. The solid phase diffusion bonding of the product is used in various industrial and constructional fields to make making to high performance. Diffusion bonding gives many advantages, mainly the strength of the bonding line, which is equal to the base metals. The microstructure at the bonded region is exactly the same as the parent metals. On the other hand, this advantage joining process requires prier cleaning process and surface polishing methods which are free from oxides, etc., high temperature condition to promote diffusion process. In diffusion bonding, the bond strength is achieved by optimum pressure, optimum temperature, Holding time of contact, and cleanness of the surfaces. The strength of the bond is primarily due to diffusion rather than any plastic deformation. Diffusion bonding is an attractive manufacturing option for joining dissimilar metals and for making the component with critical property continuity requirements. Unlike other joining processes the diffusion bonding process preserves the base metal microstructure at the interface. Some metals will unite to form a homogeneous structure when placed in intimate contact under temperature and pressure. This property results in a union where the joint is metallurgically and detectable, i.e., grain boundaries are not confined to the original joint face. For practical purposes the intimate contact and atomic exchange is assisted by heat and pressure from an external source, although no melting of the material takes place. Bond strengths up to parent material properties are achievable. The joining aspect of the process is similarly concerned with elevated temperature flow properties and fine grain sizes. After that we are including vibration analysis like modal analysis to find out the modal frequencies. It is the dynamic properties of structure under the force excitation. Modal analysis is one of the measuring dynamic property of the structure .

Mirror Polishing By Using Surface Disk Machine

The recent engineering science for used techniques like various welding process in this World. Nowadays we are making bimetallic material by various dimensions and material like Aluminium6061 and copper. Aluminium6061 thickness 20mm and diameter 40mm same dimensions of copper we are taken. Due to it's both material or relative cost comparing to other material is very less and there is no possible for metal joining process for low cost and economically in other welding process. We are following this material which is used to good thermal and electrical conducting.

Surface Disc Polishing Machine

Machine to mirror polishing by using surface disk machine . It is used to good bonding. After that Aluminium6061 and copper are adopting chemical cleaning process by using acetone for reduce other foreign particles and formation of corrosion resistance. Any intervening material between the two metallic surfaces may prevent adequate diffusion of material. Once clamped, pressure and heat are applied to the components, usually for many hours. Pressure can be applied using a hydraulic ram at temperature, this method allows for exact measurements of load on the parts. In cases where the parts must have no temperature gradient, differential thermal expansion can be used to apply load. By featuring parts using a low expansion metal part will supply their own load by expanding more than the fixture metal at temperature. Diffusion bonding must be done in a vacuum or inert gas environment when using metals that have strong oxide layers aluminium6061 & copper.

Elevated temperature and pressure causes accelerated creep in the materials; grain boundaries and raw material migrate and gaps between the two surfaces are reduced to isolated pores. Material begins to diffuse across the boundary of the abutting surfaces, confusing this boundary and creating a bond.

Diffusion bonding Process Mechanism

Stage 1: Holding at temperature and under pressure causes continued growth of contact asperities.
Stage 2: Through creep, while the influence of temperature alone causes surface boundaries to begin to migrate into more energetically stable arrays.
Stage3: As the effects of temperature and pressure continued the contact area approaches 100% and only small voids are left behind at the faying surface location.
Stage4: Further, as interfacial or grain boundaries leave the original faying surface, the joint becomes relatively indistinguishable except for residual voids. Finally disappears through continued diffusion process.

Table 1. Diffusion bonding parameters

Sample No	Optimum Temperature	Optimum Pressure	Holding time
1	500^0C	1500mpa	1hr
2	525^0C	1500mpa	1hr
3	550^0C	1500mpa	1hr

Fig 1. Bonding Samples

sample 2 sample 1 sample 3

Modal Analysis

Modal analysis is defined as the study of the dynamic characteristics of a mechanical structure. this application note emphasizes experimental modal techniques, specifically the method known as frequency response function testing.

we describe a structure in terms of its natural characteristics which are the frequency, damping and mode shapes its dynamic properties. , i often explain modal analysis in terms of the modes of vibration of a simple shaft. let’s apply force to one mode point of the shaft we will also measure the response of the shaft due to the excitation with an accelerometer attached to shaft.

Experimental Modal Analysis

The manufacturing bimetallic Al6061 and Cu material was clamped both sides like simply supported beam. **dewi software** analysis was used to measure the frequency ranges of bimetallic material when the varies load are act to using the modal hammer.

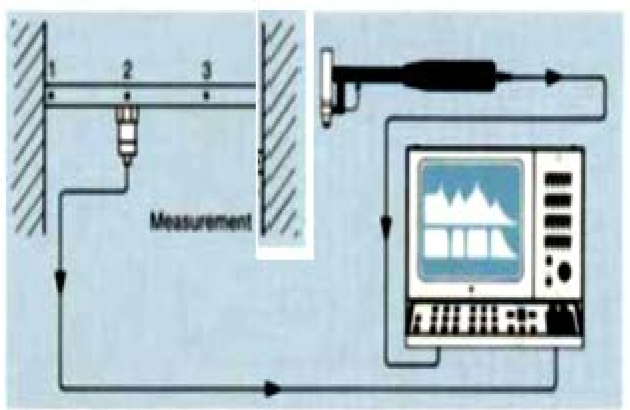

Fig 2.Experimental analysis setup

Modal analysis

Modal analysis is the study of the dynamic properties of structures under vibrational excitation. Modal analysis is the field of measuring and analyzing the dynamic response of structures and or fluids during excitation. Examples would include measuring the vibration of a car's body when it is attached to an electromagnetic shaker, or the noise pattern in a room when excited by a loudspeaker. Modern day modal analysis systems are composed of 1)sensors such as transducers (typically accelerometers, load cells), or non- contact via a Laser vibrometer, or stereophoto grammetric cameras 2) data acquisition system and an analog-to-digital converter frontend (to digitize analog instrumentation signals) and 3) host PC (personal computer) to view the data and analyze it.

Classically this was done with a SIMO (single-input, multiple-output) approach, that is, one excitation point, and then the response is measured at many other points. In the past a hammer survey, using a fixed accelerometer and a roving hammer as excitation, gave a MISO (multiple-input, single-output) analysis, which is mathematically identical to SIMO, due to the principle of reciprocity. In recent years MIMO (multi-input, multiple-output) have become more practical, where partial coherence analysis identifies which part of the response comes from which excitation source. Using multiple shakers leads to a uniform distribution of the energy over the entire structure and a better coherence in the measurement; on the other hand, a single shaker may not effectively excite all the modes of a structure. Typical excitation signals can be classed as impulse, broadband, swept sine, chirp, and possibly others.

Each has its own advantages and disadvantages. The analysis of the signals typically relies on Fourier analysis. The resulting transfer function will show one or more resonances, whose characteristic mass, frequency and damping can be estimated from the measurements. The animated display of the mode shape is very useful to NVH (noise, vibration, and harshness) engineers. The results can also be used to correlate with finite element analysis normal mode solutions.

Experimental modal Procedure

Aluminium6061 & copper bimetallic shaft of required dimension 20Ø X20 mm was cut from a bulk available shaft. By the use of vernier gauge were measured required dimension.40 mm length of the shaft was properly inserted to the fixture like the simply supported beam. The connections of the FFT analyzer, laptop, transducers, and model hammer along with the requisite power connections were made. The accelerometer -4507 type was fixed by beeswax to the simply supported beam at one of the nodal points. The 2302-5 modal hammer was kept ready to struck the beam at the singular points. Then at each point the modal hammer was struck once and the amplitude Vs frequency graph was obtained from graphical user interface. The FFT analyzer and the accelerometer are the interface to convert the time domain response to frequency domain. Hence the frequency response spectrumH1 (response, force) was obtained. By moving the cursor to the peaks of the FFT graph (m/s2/N), the cursor values and the resonant frequencies were recorded. At the time of the striking with modal hammer to the singular point precautions were taken whether the striking should have been perpendicular to the aluminum beam surface. The above procedure is repeated for all the nodal points.

Experimental result

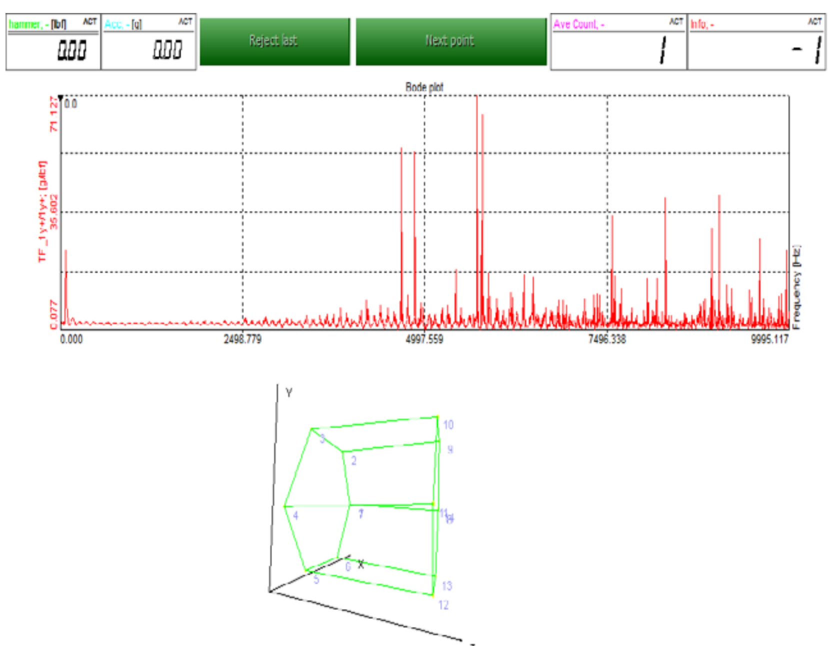

Fig 3.Modal analysis for First Node

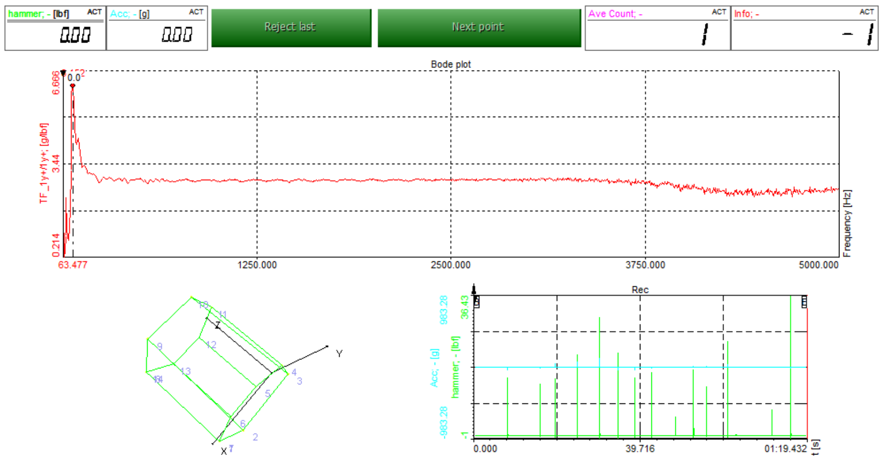

Fig 4. Response from Accelerometer

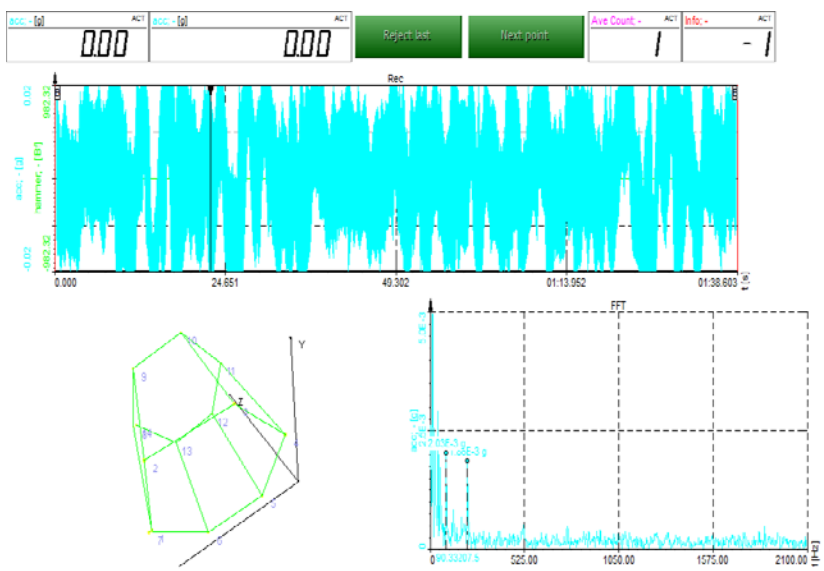

Fig 5. Frequencyresponse for first node

CONCLUSIONS

It is noteworthy that the same equipment can be used for diffusion welding of different types of materials without the need for physical alteration of the machine. For such purpose it is only necessary to change the process parameters. Furthermore the results indicate that the process can be used in the manufacture of components for the accelerators of electrons, especially in vacuum chambers and related accessories. This work leads to very appealing thoughts about modal analysis. This work is carried out to find the mode shapes and safe frequencies which the material can design.

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