Studies on Mechanical, Morphological Analysis of Ti – B_4c Composites

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Abstact-**Now a day's automobile industries and medical application were more concentrating in replacing with a light weight material thereby the fuel consumption of the vehicle can be reduced. Titanium is comparatively material and its mechanical properties can be further more increased by proper alloying and reinforcement. However, commercial applications of titanium alloys in important structural parts are limited because of hardness properties. To meet the demands of more applications, titanium alloys with high strength and excellent room temperature properties must be developed. A major issue is achieving the best potential of (B_4C) Boron carbide reinforced metal matrix composite is to disperse homogeneously within the matrix of Titanium by using powder metallurgy technique namely , blending , compacting, sintering was conducted. Then it sinter into 1200^{0}C in vacuum atmosphere. Scanning electron microscopy (SEM) by using this to characterized the sintered samples. The mechanical properties of newly formed titanium composite were need to measure by micro hardness, and compressive test.**

1. INTRODUCTION

Powder metallurgy is a process of blending fine powdered materials, pressing them into a desired shape or form (compacting) and then heating the compressed material in a controlled atmosphere to bond material (sintering). The preparation and processing of powdered iron and nonferrous metals is called as Powder metallurgy. Many metals can be obtained in the form of fine powder, by different methods. Parts made in these way exhibit properties which cannot be produced in any other way. The powdered metal is then compressed in moulds under high pressure. By subsequent heating a fairly strong component is obtained. The Powder metallurgy consist of four basic steps Powder Manufacture , Powder blending, Powder compacting, Powder sintering Compacting is generally performed at room temperature, and elevated temperature process of sintering is usually conducted at atmospheric pressure. The main process consists in cold pressing the metal powders followed by heating. The temperature during the heating process is kept below the melting point in case of pure metals but with alloys the melting point of one constituent is often exceeded. Bonding is obtained by cold pressing but sometimes nonmetallic materials are added to provide metallic bond. Final cohesion is caused by heating in suitable atmosphere.

2. EXPERIMENTAL DETAILS

2.1 Titanium

Titanium is a chemical element with symbol of Ti. It is a lustrous transition metal with a silver color, low density and high strength. It is highly resistant to corrosion in sea water, aqua regia and chlorine. Titanium can be alloyed with iron, aluminum, vanadium & molybdenum among other elements to produce strong and lightweight alloys for Aerospace jet engines, missiles and spacecraft. Titanium Powder metallurgy offers the possibility of creating net shape (or) near net shape parts without the material loss and cost associated with having to machine intricate components from wrought billet.

2.2 Boron Carbide

Boron Carbide (B_4C) is crystalline compound of boron and carbon. The Another name of Boron Carbide is Carbon Tetra boride, it molecular weight is 55.25.It is an extremely hard boron-carbon ceramic material used in tank armor, bullet proof , vests engine sabotage powders, as well as numerous industrial applications. With a Mohs hardness of about 9.497,it is a one of the hardest materials known being cubic boron nitride and diamond Boron carbide it's insoluble in water. The ability of boron carbide to absorb neutrons without forming long lived radio nuclides makes it attractive as an absorbent for neutron radiation arising in nuclear power plants. Nuclear applications of boron carbide include shielding, control rod and shut down pellets. Within control rods, boron carbide is often powdered, to increase its surface area. The ability of boron carbide to absorb neutrons without forming long lived radio nuclides makes it attractive as an absorbent for neutron radiation arising in nuclear power plants. Nuclear applications of boron carbide include shielding, control rod and shut down pellets. Within control rods, boron carbide is often powdered, to increase its surface area

2.3 Preparation of Die & Die Manufacturing

Die is a hollow or solid metal form used in cutting aping coins or shape, drawing bars or wires, embossing (or) thread insides (or) outsides. Hollow die used in casting of forming is also called as mold. A die specialized tool used in manufacture industries to cut on shape material mostly using a press. Like in olds dies are generally customized to the item they are used to create products made with dies range from

simple paper lips to complex pieces used in advanced technology.et in Chennai. The Elements used in the Preparation of die materials are D_2 steel. The high carbon high chromium (HCHR) material is used to make elements like Upper Punch, Lower Punch, and Injector.

2.4 Powder Compacting

It is the process of compacting metal powder through the application of high pressures. Compacting or briquetting is the process of converting loose metal powder particles into a Green Compacting as it is called of accurately defined size and shape. The Briquette is considered fairly fragile, but it can be handled. The Compacting stage is carried out at room temperature in a die set up on press. The die consists of cavity, the shape of the desired part, but from two to ten times deeper, according to the material handled. Pressure is applied by the upper and lower punch and the powder gets compressed to approximately one third of its volume and the required component is produced. The bottom punch also acts as ejector for the compressed parts. The dies are commonly made up of high carbon steel and high chromium vanadium steel. Metal powder is poured in the cavity, and leveled off flush with the top of the die. When compacting briquettes from hard materials, most of the holding force between the powder particles results from an interlocking effect which takes place between the irregular surfaces of the powder particles. A binder is usually needed to make the compact self-supporting. The process used for compacting may be either mechanical or hydraulic or a combination of the two and the pressure used in form 100 to 1000N/m2.

2.5 Pre sintering

Pre sintering is the process of heating the green compact to a temperature below the sintering temperature. This is done to remove the lubricants and binders added during blending and to increase the strength of compact. All metals do not require pre sintering. But some metals like tungsten carbide are easily machined after pre sintering. After sintering they become so hard that they cannot be machined.

2.6 Powder Sintering:

Sintering is a process of taking metal in the form of a powder and placing it into a mold (or) die. Once compacted into the mold the material is placed under a high heat for a long period (or) time. . It may also be carried out under protective gas normally hydrogen or in a vacuum if the material tends to react with the protective gas. The heating causes the metal particles to sinter, that is a proportion of them partly melt and by so doing cement the remaining particles together in a cellular structure. From the economic point of view, the sintering time should be as short as possible, but the time must be long enough to obtain the required properties.
Sintering is performed to achieve all possible final strength and hardness needed in the finished product. The three most important variables governing the sintering process are temperature, time and sintering atmosphere. The work piece dimensions change during sintering. Such changes may be either a shrinkage or growth. In general, bronze tends to expand and iron and brass to contract. After being compacted into a briquette having the shape of the finished work piece, the cold welded aggregate of metal particles is heated in a furnace to the temperature close to the melting point of the basic metal which goes into the mixture. This is carried out in controlled atmosphere furnaces billets are consolidated for Sintering in the Furnace under the temperature of the 1200^0c at the approximate 5hours in the furnace

3. TESTING

3.1 Scanning electron microscopy

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning it with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that can be detected and that contain information about the sample's surface topography and composition. The electron beam is generally scanned in a raster scan pattern, and the beam's position is combined with the detected signal to produce an image. SEM can achieve resolution better than 1 nanometer. Specimens can be observed in high vacuum, in low vacuum, in wet conditions (in environmental SEM), and at a wide range of cryogenic or elevated temperatures. The most common mode of detection is by secondary electrons emitted by atoms excited by the electron beam. On a flat surface, the plume of secondary electrons is mostly contained by the sample, but on a tilted surface, the plume is partially exposed and more electrons are emitted. By scanning the sample and detecting the secondary electrons, an image displaying the topography of the surface is created.

3.2 Vickers Hardness test

The Vickers test is often easier to use than other hardness tests since the required calculations are independent of the size of the indenter, and the indenter can be used for all materials irrespective of hardness. The basic principle, as with all common measures of hardness, is to observe the questioned material's ability to resist plastic deformation from a standard source. The Vickers test can be used for all metals and has one of the widest scales among hardness tests. The unit of hardness given by the test is known as the Vickers Pyramid Number (HV) or Diamond Pyramid Hardness (DPH). The hardness number can be converted into units of pascals, but should not be confused with pressure, which also has units of Pascal's. The hardness number is determined by the load over the surface area of the indentation and not the area normal to the force, and is therefore not pressure. It was decided that the indenter shape should be capable of producing geometrically similar impressions, irrespective of size; the impression should have well-defined points of measurement; and the indenter should have high resistance to self-deformation. The dictionary of Metallurgy defines the indentation hardness as the resistance of a material to indentation. This is the usual type of hardness test, in which a pointed or rounded indenter is pressed into a surface

3.4 Compression test

The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some materials fracture at their compressive

strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures. Compressive strength is often measured on a Universal testing machine these range from very small table- top systems to ones with over 53 MN capacity Measurements of compression test are affected by the specific test method and conditions of measurement. Compression test is measured on materials, components, and structures.

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