SUPERIOR EQUIPMENT AND VARNISH OUTLOOK FOR GAS TURBINE APPLICATIONS

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ABSTRACT:

The need for very specific hardness / hardness materials can only be satisfied by design concepts using reinforced compounds. Carbon fiber made of high-strength and durable silicon in a high-temperature titanium matrix is one of the main candidates whose development will be described. Design concepts for high-pressure turbines that incorporate thermal protection layers for ceramics, i.e. heat-insulating coatings, will go beyond the natural limits provided by the melting point of Ni-based super-turbine blades. The sophisticated design of the aerodynamic engine will focus on reducing specific fuel consumption and increasing the weight-to-weight ratio. In the end, this requires an increase in pressure ratios, as well as higher operating temperatures, and certainly poses a major challenge to the structural design and materials used. High-capacity materials for high temperatures are required, as are very light structures. Reducing the weight of the pneumatic dynamic motor requires a new compact compressor design with a few phases. Gas turbine blades are designed for cooling methods, as well as for cooling films in external cooling and thermal cooling in internal cooling. The turbine blade is designed with four-hole and six-hole heat cooling. The film cools the air in the blade through several small holes in the chassis. The current material used for the blade is chrome-plated steel. Here, it is replaced by composite materials of ceramic matrix and silicon carbide. Advanced evaporation treatment using electron beam technology is the preferred choice for manufacturing these coatings in highly rotating parts. However, considerable efforts are still needed to improve these coatings, make them more reliable, and thus achieve a philosophy designed to fully exploit their potential.

Keywords: gas turbine, rotor blade, steady state thermal analysis, fiber-reinforced composites, thermal barrier coating.

1. INTRODUCTION

During the design of the new aero engine, consideration should be given to the impact on key engine characteristics such as engine weight, specified fuel consumption (SFC), manufacturing costs and serviceability. For airlines, the direct operating costs of the aircraft are an initial qualifying parameter. Regardless of the specific fuel consumption, the propulsion / weight ratio is of great importance for military engines. The pay-to-weight ratio has been significantly improved over the years achieved by increased operating temperature and structural efficiency. It is very clear that advanced materials play a key role here. In fact, modern aircraft engines represent some of the most demanding and sophisticated building material applications in any engineering system manufactured today [1]. The first addresses recent developments in high pressure turbines /

low pressure turbines and focuses on light titanium alloys, titanium aluminates and especially titanium matrix compounds (TMCs). The second covers the thermal barrier coatings (TBCs) of high pressure turbine blades that try to get rid of the bottleneck in developing improved performance engines. The excellent properties of titanium alloys include high specific strength and excellent corrosion resistance. Therefore, titanium alloys are found in aerospace applications where a combination of weight, strength, corrosion resistance and / or high temperature stability of light metal aluminum, high strength steel or nickel based super alloys is insufficient. In air motors, titanium alloys represent the most important class of engine compressor materials. The compressor blades were the first engine components made of titanium, and the titanium compressor discs are then introduced. The large front fan blades of modern jet engines are also often made of titanium alloy. Due to the constant increase in engine deviation rates, the latest blade designs exceed one meter in length. In these dimensions, the fan blade blade can become a serious problem because the blade edges can reach the speed of sound and cause acoustic / subsonic flow areas and associated shock waves. Advanced fan designs have improved blade stiffness by increasing column width and reducing the number of blades by about one third. Today, these "wide propeller blades" are used in the latest jet aircraft engines [2]. The new Benz (G 800) and GE / Pratt & Whitney Engine Alliance (GP7200) Airbus A380 engines will be about three meters in diameter and will include hollow titanium blades. Blisk technology is now standard in low and medium sized compressors for commercial and military engines. In the Eurofighter EJ200 engine, for example, the three stages of the fan section are of excellent design; the first two are manufactured by linear friction welding and the third by ECM.

Fig 1: Three stage blisk compressor

2. METHADOLOGY

This temperature limit for titanium alloys means that the hottest parts of the compressor, i.e., the discs and the blade in the later stages of the compressor, must be made of twice the weight of nickel-based super alloys. In addition, problems arise related to different thermal expansion behaviors and bonding techniques in the two alloy systems. Therefore, huge efforts are being made to develop a compressor made entirely of titanium. Titanium alloys that can be used at temperatures around 600 ° C or higher are required. This has been the motivation for intensive research and development in the field of titanium aluminize. These substances, based on intermetallic compounds α2 (Ti_3Al) and γ (TiAl), have been studied for their ability to raise the application temperatures of titanium alloys to 650 ° C and 800 ° C, respectively. Excellent creep resistance is due to the organized nature of the crystalline structure. However, this structure also makes the intervals relatively fragile and difficult to distort. Alloys with Nb, Cr, V, Mn or Mo and microstructure optimization are two ways to increase ductility. Adequate tolerance for damage, pathological oxidation behavior and productivity (cost) are key factors that will determine the use of titanium acuminate in the aviation industry [3]. Due to the high reactivity of titanium alloys with SiC granules, manufacturing processes that occur with the least possible thermal load on the compound during manufacturing are preferred. Thus, processes based on vapor deposition and solid-state formability is considered. Today, the preferred route is fiber-coated matrix technology. The primary product is homogeneously coated matrix fibers allowing the manufacture of composite materials with excellent fiber coordination and precise matrix structure. Deposition of the magnetron spray layer from the vapor phase. Due to the high deposition rate, the electron beam vapor deposition (EB-PVD) is also used, but is limited to individual composition matrix alloys. In the second step, the matrix fibers are assembled or arranged using matrix, for example, winding techniques to achieve the desired geometry of components, encapsulated and then compressed at an even temperature at a constant temperature of about 950 ° C and pressures of about 2000. Tape. In the last step, the component is formed to its final geometry.

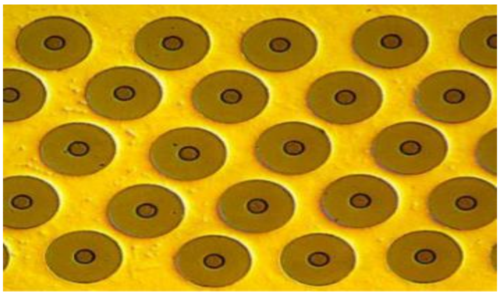

Fig 2: Titanium matrix composite

3. LITERATURE SURVEY

PAPER 1- Design and Analysis of Gas Turbine Blade by Theju V, Uday P S , PLV Gopinath Reddy , C.J. Manjunath.

The purpose of this project is to design and analyze turbine pressure. Research is required to use new materials. In the present work, the turbine blade is designed with different materials, Inconel 718 and Titanium D-6. Try to check the effect of temperature and pressure caused by the turbine code. Thermal analysis was performed to verify the direction of temperature flow due to convection. Structural analysis was performed to investigate the effect of the combination of thermal loads and centrifugal effects and shear forces and turbine plate displacement. We have tried to suggest the best fit for the turbine index by comparing the results obtained from two different substances (Inconel 718 and T6 Titanium). Based on the designs and results, Inconel 718 can be considered the best economical material and has good physical properties at higher temperatures compared to titanium T6.

PAPER 2- Heat Transfer Analysis of Gas Turbine Blade Through Cooling Holes by K Hari Brahmaiah , M. Lava Kumar

In advanced gas turbines, the operating temperature of the turbocharger operates above the melting point of the blade material. An advanced cooling system should be developed to ensure the safe and continuous operation of high performance gas turbines. Different ways of cooling the blades are offered. One of these techniques is the presence of radial holes at high air cooling speeds along the plate. Heat transfer analysis of gas turbines was performed on four different sample blades without holes (5, 9 and 13) with holes. Reinforced wall). For heat transfer graphics and overall distribution, the code is optimized for 13 holes. A consistent and consistent analysis is performed using ANSYS with different chrome-plated steel blades and Inconel 718. Comparison of these materials shows that although Inconel 718 has excellent thermal properties, the induced stress is lower than chromium steels.

PAPER 3 - Film Cooling of the Gas Turbine Endwall by Discrete-Hole Injection by M. Y. Jabbari, K. C. Marston, E. R. G. Eckert and R. J. Goldstein

The film's cooling performance is tested for injection through separate openings at the end of the turbine blade. Efficiency is measured at about 60 sites in the injection area. Three nominal hit rates, two density rates and two Reynolds flow numbers are examined. Data analysis reveals that up to 60 locations are insufficient to determine the extent of the film's cooling effect with its strong local variations. Viewing the effects of cooling jets on the perimeter wall using ammonium diazo paper provides useful quality information for interpreting measurements, pathways and jet responses that change at fast speed and flow rate. intensity.

4. RELEATED STUDY

In general, composite materials are highly dependent on the properties of the solvent. Understanding the interaction between them forms the basis for physical evolution. The specificity of embedded properties always depends on the stability of these reactions. Long-term durability and robustness to the highest service temperatures are definitely a highlight of the enhanced TMCs. Energy, or more energy, energy associated with mass, is an important factor for structural simplicity and is a valuable property of great importance in design [4]. Dynamic aerospace and TMC data are shown in Figure 6 for temperatures up to 700 ° C. Although they are strong (or medium), the aluminum alloys, α2Ti3Al or mushrooms (Ti2AlNb), al-alumate, and suparalloysi (here 718) cover 10 to 25 km at room temperature and from 10 to 15 km at 800 ° C, The maximum TMC strength ranges from 40 to 60 km at room temperature and up to 50 km at 800 ° C. Maximum strength depends on the fiber part. A maximum of 40% electrical fracture was obtained. For SiC / TIMETAL 834, the maximum heat resistance of 2400 MPa is recoverable, which is well consistent with the calculations according to chemical law. The use of TMCs in advanced applications for advanced jet engines requires less energy; if the behavior is weak under heavy load, it is one of the most important criteria. Figure 7 shows the nonlinear force with reinforced SiC fibers 5 Christoph Leyens TIMETAL 834 under friction jump at temperatures up to 700 ° C. The TMCs have a positive effect, particularly at 700 ° C where the fiber strength is high in conductivity. The periodic pressure levels of TMC antagonists in LCF (low fatigue state) and HCF (high fatigue condition) were more than 100% greater than nonlinear ones. Although the maximum continuous closure is about 400 MPa, SiC / Ti reaches a fixed limit of more than 1000 MPa at 700 ° C.

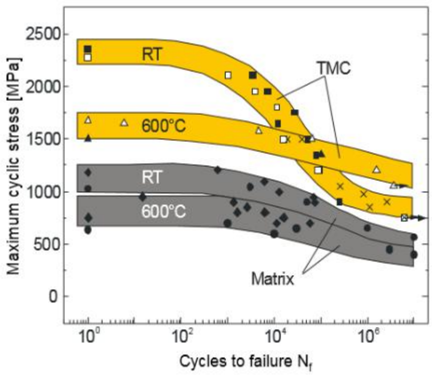

Fig. 3: Fatigue strength of TMCs in comparison

5. APPLICATIONS

The future development of natural gas is clearly aimed at raising the temperature of the turbine marine to more than 1700 ° C. There is no doubt that this ambitious goal can be achieved through by using non-economical televisions or by high temperature applications, in particular by expanding the use of heat exchangers (EB-PVD) using electromagnetic fields (TBCs).). Chlorofluorocarbons (CFCs) consisting of hot-tempered layers with reduced thermal conductivity - usually zirconia-stabilized particles - are used in the air and only in powder form skin. The paint showed good consistency of cement in the material [5] [6]. The TBCs application allows for increased engine / performance by increasing the temperature or reducing air conditioning. On the other hand, it is possible to extend the life of turtles by reducing the heat of iron as shown. During the process of EB-PVD, the strong electric field is melted and the cement material is transferred into a vacuum chamber. The cells are inserted internally during the healing process to ensure continued TBC. To achieve the measurement of specific elements of zirconium, the amount of oxygen is compromised in the discharge chamber. Intravenous reservoirs are placed on a storage tank at a rate of 3 to 30 microns / min. Specialized and polished microspheres provide smooth surfaces without the need for final drying or cooling. Due to the microscopic structure, the life of TBCs is prolonged and impairs tolerance. Characteristics and many advantages of TBCs compared to heat exchanger and evaporator featuring EB-PVD TBC on a steam engine powered by DLR using 150kW von Ardenne EB-PVD.

6. CONCLUSION

Mechanical devices, including high-strength, high-strength and high-strength fiber-reinforced titanium matrix materials, are ideal for high-tech applications, for example in turbine engines. Due to high costs and lack of knowledge of real estate, their use is severely restricted by applications. The following procedures should enhance TMC's ability to increase acceptance in the manufacturing market. Although most TMC applications today focus on temperature, the future of TMC is likely to be a future at high temperatures. For large-scale heat exchangers such as power plants, Eb-PVD shows the highest potential for increasing turbine power. TBCs represent a complex process involving (at least) attachments, bandages, heat transfer heaters and top cover. Each species can affect the life cycle of tuberculosis through a strong immune system. Complex and commonly used conditions, thermal, mechanical and mechanical conditions of the equipment, including heat transfer and cyclic effect, aggravate the situation.

7. REFERENCES

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