appropria_4e conditions identified in the experiment, a bending strength of 63MPa and a Young's modulus of 1.5 GPa are attained when the load is applied parallel to the lamination direction, whereas those vertical to the lamination direction are 79 MPa and 1.8 GPa, respectively. The size of pores varies from 200 to 300nm, and the porosity is approximately 65%. These values except Young’s modulus are almost equivalent to those of human bones.

APP-06: Experimental Analysis of Flow, Stress and Strain Distribution in Powder Compaction by Flat Rolling

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Pure aluminum and Al-Si alloy powders were compacted by cold flat rolling and the mechanical properties such as Vickers hardness and tensile strength of the compacts were discussed. Their properties depend on the deformation behavior of powder particles during the rolling. Flow, stress and strain distributions in the flat rolling of alloy powder were experimentally analyzed by the modified viscoplasticity method in order to investigate the internal deformation behavior in the powder forming. After forming, specimen was cut out in half along the longitudinal direction involving the center line. Initial shape of every particle was assumed to be spherical and the distorted shapes of particles at the various points of the cross section were measured experimentally. It is observed that the composition of the powder has great influence on the flow, stress and strain distribution. As a result, it is made clear that this modified viscoplasticity method is very useful and applicable for the evaluation of flow, stress and strain distribution in powder rolling.

APP-07: Bonding of Mechanically Alloyed Powder and Magnesium Alloy by Compressive Deformation

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Atomized aluminum powder mixed to magnesium alloy (AZ31) machined chips with Mg-12, 40 and 61.5 mol%AI compositions and then the powder mixtures were mechanically alloyed (MA) for 54ks. For the surface improvements of the magnesium alloy, the obtained MA powders were stacked on magne-sium alloy (AZ31B) rod as the substrate, and they were bonded by hot-compressive deformation at various temperatures. After the bonding of Mg-12mol% Al MA powder to AZ31B substrate at 673K over, Mg12Al12 phase precipitates from super-saturated α-Mg in the bonded alloy layer. The structure in the bonded al-loy layer of Mg-40mol%Al MA powder becomes to Mg12Al12 single phase. In the case of Mg-61.5mol%Al MA powder, the amorphous phase formed by MA transforms to Mg2Al3 and Mg4Al phases. The hardness in the alloy layer bonded MA powder becomes higher than as-MA powder particles. If the MA powder bonds to AZ31B alloy substrate by the compressive deformation at high temperature, the gradient of Mg and Al concentrations forms in the bonding interface by diffusion phenomenon.

APP-08: Shape Memory Characteristics of TiNi Alloy Fabricated by Mechanically-Alloyed Powder

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This paper presents the fabrication condition of the TiNi shape memory alloy powder by mechanical alloying and the shape memory characteristics of the sintered TiNi alloy of the mechanically alloyed powder (MA powder). The effect of mechanical alloying conditions on the characteristics of MA powder was investigated. The MA powder was fabricated by milling, using a planetary ball mill in rotational speed from 200 rpm to 500rpm for various milling times in an atmosphere of Ar gas. The various MA powders were sintered by a pulse-current pressure sintering equipment at various temperatures. The carbon content of the MA powder increased with increasing rotational speed, while the oxygen content of the MA powder milled at a lower rotational speed was higher than that of the MA powder milled at a higher rotational speed. The density of the sintered compact of the MA powder was lower than that of the sintered compact of the elemental Ti and Ni powders, but the microstructure of the former was much more homogeneous than that of the latter. The transformation temperatures of the shape memory treated compact of the amorphous MA powder were similar to those of the wrought alloy, while those of the non-amorphous MA powder lowered with heat treatment because of the inhomogeneous microstructure of the sintered compact.
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Several generations of organosilicon polymer based SiC fibers have been produced such of irradiation curing for the lower oxygen content, and the improvements have lead to near-stoichiometric SiC composition. The near-stoichiometric SiC fibers have been estimated excellent in the long-service-life of potential CMC applications such as gas turbines and fusion reactors. However, the organosilicon polymer based SiC fibers have been reported to possess variable diameter, which leads to biased strength from the intrinsic material strength. Thus, the strength superiority due to the stoichiometric composition might have been underestimated in the application studies. The authors discuss in this work the Weibull strength scaling of organosilicon based near-stoichiometric SiC monofilaments: Hi Nicalon Type STM, Tyranno SATM, and SylytricTM. The material strength, or the strength of imaginary uniform diameter fibers, has been estimated using modified Weibull scaling, which couples the tensile loads and measured diameters. The estimation revealed the drastic superiority of the strength over the known data by the suppliers.

CMC-05: Transient Creep Behavior of a Plain Woven SiC Fiber / SiC Matrix Composite
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The present work investigates the tensile stress / strain behavior of a plain woven Tyranno™ Lox-M (Si-Ti-C-O) fiber / SiC matrix composite at 1473 K in air. Tensile creep tests were carried out under a constant load between 80 and 160 MPa. A creep strain rate is generally represented by the Bailey-type relationship with a constant strain exponent, however the strain exponent decreased with time for this composite material. Monotonic tensile tests were also conducted for loading rates of 0.03, 0.3, and 3 kN/min in order to investigate the effect of creep strain on tensile stress/strain behavior. Based on the empirical transient creep equation and creep-hardening model, stress/strain curves under monotonic tensile loading were predicted. A good correlation was obtained between the predicted and measured composite stress/strain curves using strain-hardening model.

CMC-06: Synthesis and Characterization of SiC Ceramics for High Temperature Resistant Coatings and Matrix
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SiC ceramics are expected as oxidation resistant coating material for Carbon/Carbon (C/C) composites. In the present study, SiC ceramics were synthesized through Sol-Gel method with low environmental impact. The gels were synthesized from ethylalcohol, methyltriethoxysilane (MTES), hydrochloric acid (HCl) and purified water (H2O), and it was pyrolyzed at 1000, 1500 and 1700°C. The structures of gels after heat treatment were analyzed by X-ray diffraction (XRD). XRD results indicated that b-SIC were obtained in the present method and crystallization was increased with increasing heat treatment temperature, however, the number of cracks also increased with temperature. Thus, heat treatment temperature of 1000°C was selected for the coating process. There was little weight change in synthesized SiC obtained at 1000°C in air, which results in lower weight changes in SiC coated C/C composites comparing with bare C/C composites. However, SiC coated C/C composites were also oxidized because of the generation of cracks during heat treatment at 1000°C. To reduce the crack opening displacement, two cycles SiC coated C/C composites were also fabricated in the similar method of one cycle SiC coated C/C composites. Optical microscope observation showed that two cycles SiC coated C/C composites had low crack opening rather than one cycle SiC coated C/C composites. Residual tensile strength of SiC coated C/C composites after 5 minutes oxidation became higher with increasing number of coating cycles.

CMC-07: Stress Analysis of Sapphire Wafers Subjected to Thermal Shocks
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Sapphire wafers used in semiconductor industry often experience stresses and deformation induced by rapid heating or cooling. In order to understand the mechanisms and evolutions of the thermal stresses, a three-dimensional finite element model of a single sapphire wafer was developed to analyze the transient heat conduction in conjunction with the heat radiation and heat convection on the wafer surfaces. A single silicon wafer was also analyzed for comparison. It was found that the rapid thermal loading leads to a non-uniform parabolic radial temperature distribution, which results in thermal stresses even if the wafer is not mechanically restrained. The maximum tensile stress appears at the point of the minimum edge-to-centre temperature drop in the cooling phase, but the maximum shear stress occurs at the point of the highest temperature in the heating phase. It was calculated that a longer holding time for temperature stabilization will help achieve a uniform temperature distribution within a sapphire wafer but will lead to a higher tensile stress at the end of the process of cooling.

CMC-08: Synthesis and Characterization of Microwave and Conventional Combustion Synthesized Alumina - Titanium Carbide Powders
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Al2O3-TiC powders were produced from the microwave and conventional-combustion synthesized mixture of TiO2, C and Al. Different types of precursors such as rutile and anatase TiO2, as well as carbon black, graphite and activated carbon powders were used. The different type of precursors and heating method affected the combustion behavior. The combustion under microwaves could be achieved in less than 10 min which was 10 times faster than conventional combustion. The composition of rutile-carbon black-aluminum gave the shortest ignition time under microwave energy, whereas the mixture contained activated carbon ignited fastest under conventional heating. Nevertheless, in both cases, samples with anatase required longer time to ignite and thus gave higher combustion temperatures than ones with rutile. An incomplete combustion of product that used activated carbon as carbon source was observed. The synthesized powder was fragmented and angular shaped with largest agglomerate size limited to smaller than 25 microns.