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ABSTRACTS

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weight percent of BN nanotubes were fabricated via hot pressing. Room temperature strength and fracture toughness of the composite were determined by four-point flexure and single edge V-notch beam methods, respectively. The strength and fracture toughness of the composite were higher by as much as 90% and 35%, respectively, than those of the glass G18. Microscopic examination of the composite fracture surfaces using SEM and TEM showed pullout of the BN nanotubes, similar in feature to fiber-reinforced ceramic matrix composites with weak interfaces. Other mechanical and physical properties of the composite will also be presented.

G-2: P21 **Microstructure and Mechanical Behavior of ZTA and ATZ Mixed Ceramic Composites**

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The effect of compositions of Al2O3:(ZrO2:Y2O3) composites on the mechanical properties was investigated. Several composites of alumina reinforced yttria partially stabilized zirconia (ATZ), zirconia toughened alumina composites (ZTA) and different compositions of ATZ:ZTA were prepared by mechanical mixture and pressureless sintering at temperatures between 1500 and 1600 °C/2h. The microstructures of the sintered samples were examined by scanning electron microscopy and the crystalline phases identification was performed by X ray diffractometry. The hardness and fracture toughness of the composites were determined through Vickers Indentation Method and the flexural strength through four-point bending at room temperature. The interaction of mechanical characteristics of the composites and its influence on the microstructure for different compositions were studied.

G-2: P23 **Structure and Properties of Heterophase Nano-structured Ceramics**

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The paper is dedicated to the study of the interdependence of structure and properties of sintered heterophase ceramic compositions based on ultra-fine (nanosized) powders. The compositions based on brittle oxygen-free high-strength compounds under certain conditions are able to demonstrate micro-plasticity. Microstructure of such materials typically features homogeneous fine grains with a certain critical maximum grain size. The substantial contribution of interphase boundaries and their dislocation structure to the non-trivial mechanical properties is discussed. Special features of interphase boundaries are demonstrated to contribute to the change in rupture resistance of the heterophase ceramics. Correlations between strength and elastic properties and results of tribological tests using "pin and disc" arrangement were studied. Increased fracture resistance, wear-resistance and micro-plasticity of heterophase ceramics is found to be due to the modification of microstructure size parameters and distinctive features of interphase boundaries.

Application Engineering

G-3: P26 **Ceramic Composites with Thermo-mechanical Properties for Dental Applications**

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The ceramic composites from the quaternary Al_2O_3-SiO_2-MgO-ZrO_2 system, with the major compounds: mullite, cordierite, zircon silicate and silica have important dental applications, because of their interesting thermo-mechanical properties. Materials can be obtained which have high purity, good homogeneity, fine dimensional precision, and also very good thermo-mechanical properties (thermal expansion coefficient from 20 to 920 °C between 3 and $5 \times 10^{-6} K^{-1}$), extremely good chemical stability, with almost total elimination of the risks related to toxic inclusions in dental materials. Several programs were proposed for obtaining samples of ceramic composite materials from four different compositions and their influence on the properties was determined. The chemical composition influence on the thermo-mechanical properties was also studied, especially for the systems with different proportions of cordierite. The samples were investigated through the determinations of density, porosity, water absorption, mechanical strenght, thermal expansion coefficient, thermal schock resistance, chemical resistance, X-ray diffraction, Raman and FTIR Spectroscopy, Scanning Electronic Microscopy-SEM.

G-3: P27 **New Generation of CBN Grinding Wheels Bonded with Glass-ceramic**

D. Herman, Technical University Koszalin, Koszalin, Poland

Ceramic grinding wheels are made of cubic boron nitride bonded with glass-ceramic. Such grinding wheels are mainly designed for the modern high-efficient and high-speed abrasive machining of work surfaces. Due to the requirements for high mechanical strength of these grinding wheels, the cubic boron nitride bonding phase should be characterized by higher strength than the previously used vitrified bond. The application of glass-ceramic bonds make it possible to achieve the higher elastic modulus of grinding wheels.

SECTION H

CERAMIC JOINING

Oral Presentations

Session H-1

Wetting and Interfaces

H-1: IL01 **The Contribution to Theory of Ceramic/Liquid Metal Interfaces. The Wetting Process Peculiarities for Transition and Nontransition Metals**

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The theoretical concepts on thermodynamic and atomic-electron level for high temperature wettability processes in ceramic/metal systems are considered and developed. The ceramic materials (on base of oxides, carbides, carbon substrates e. c. with ionic or covalent interatomic bonds) are as usual hardly wetted by many liquid metals. The wettability is conditioned by chemical interface reaction in nonequilibrium contact systems (dissolution of solids in liquid, diffusion of liquid phase atoms in solid, new phase formation) that gives directly an energy contribution to the work of adhesion, and nature and properties of new intermediate phase (if formed). Both contributions to the work of adhesion and wettability: chemical reaction energy and new phase influence are estimated for some real systems and it is shown that they have a comparable values. The wetting and interface interaction mechanism is considered in particular for contact of liquid metals with ionic substances (first of all-oxides). The transition metals (with partly occupied d-electron bands) play the special role in the process that provides high wettability. The strong cation-cation bonds of metallic character exist in lower oxides and for electronic configuration $3d^m$ ($m \leq 5$, better $m \leq 3$). The bonds are determined by overlapping of cation d-electron wave function on triple degeneration t_{2g} level (d_{xy}, d_{xz}, d_{yz}) if transition metal cation is in an octahedral interstice of an anion sublattice and high spin state (non coupled spin) is realized (Ligand field theory). After interface