

Soviet and Japanese Aerospace Literature

Throughout 1990 the *AIAA Journal* will carry selected abstracts on leading research topics from the Soviet aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Ceramics from the USSR and Japan.

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Soviet Aerospace Literature This month: *Ceramics*

A90-24215 Fracture relief formation in a ceramic in the subcritical crack growth region (Formirovanie rel'efa izloma keramiki v oblasti dokriticheskogo rosta treshchiny). V. G. BOROVIK, *Problemy Prochnosti* (ISSN 0556-171X), Jan. 1990, pp. 37-43. 15 Refs.

A model for the formation of the fracture geometry in ceramics is proposed which is based on a representation of the fracture process as a combination of mutually independent acts of intergranular and intragranular tearing fracture. It is found that the fracture surface geometry changes with an increase in stress intensity factor, with a practically flat geometry observed for the critical stress intensity factor of a polycrystal. Calculations of the fracture toughness of an Al₂O₃ ceramic are presented.

A90-22807 Photoelectron emission of Y-Ba-Cu-O ceramics (Fotoelektronnaya emissiya Y-Ba-Cu-O-keramik). B. A. SORKIN and KH. KIAEMBRE, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, Nov. 26, 1989, pp. 4-8. 12 Refs.

Spectra of the quantum yield gamma (hnu) of photoelectron emission in the near-threshold spectral region hnu = 2.4-5.4 eV were investigated for YBa₂Cu₃O (7-delta) specimens with different conductivity and superconductivity characteristics. Three groups of specimens were studied and compared: metallodielectrics which become superconducting under cooling by liquid N₂; (2) samples that do not exhibit superconductivity under liquid N₂ cooling and that possess semiconducting properties; and (3) dielectric Y₂BaCuO₅. The photoelectron yield is found to be smallest for the superconducting specimens and greatest for the dielectric specimen.

A90-16577 Current problems of the material science of superplasticity. O. A. KAIBYSHEV, *Superplasticity and superplastic forming; Proceedings of the International Conference*, Blaine, WA, Aug. 1-4, 1988 (A90-16576 04-26). Warrendale, PA, Minerals, Metals and Materials Society, 1988, pp. 3-15. 13 Refs.

The current material science problems of superplasticity are reviewed with particular reference to the regularities of fine grain microstructure formation in commercial alloys and the possibility of intermetallics and ceramics conversion to the superplastic state. During the hot straining under certain temperature-rate conditions the formation of a fine grain microstructure in metals, intermetallics, and ceramics is followed by their transition to the superplastic flow. The phenomenological and structural changes during the superplastic flow of the said materials are identical, which indicates the universal character of deformation mechanisms operating under these conditions. For the superplasticity effect to be displayed, the enlargement of the ordinary high angle boundary regions in a polycrystal is of crucial significance.

A90-22388 P/M friction materials (Review) (Friktsionnye poroshkovye materialy /Obzor/). G. M. DERKACHEVA and I. I. PANAIOTI, *Poroshkovaia Metallurgiya* (ISSN 0032-4795), Dec. 1989, pp. 69-78. 73 Refs.

The available data on the compositions and methods of fabrication of P/M friction materials are briefly reviewed. It is shown that most of the general-purpose friction materials (such as those used for the fabrication of brake shoes and clutch disks) are materials based on iron and copper. In addition to the existing fabrication processes, new processes for producing friction materials are currently being developed which do not use high pressure during sintering. Such processes include plasma spraying, electrolytic coating deposition, and powder rolling.

A90-19233 A study of the multiplex methods of spatial-temporal light modulation in one-dimensional PZLT-ceramic spatial-temporal light modulators (Issledovanie mul'tipleksnykh metodov prostanstvenno-vremennoi moduliatsii sveta v odnomernykh TsTSL keramicheskikh PVMS). A. V. GUK, P. I. KOLENNIKOV, V. R. MALAKHOVSKI, and E. G. PAPERNO, *Avtometriia* (ISSN 0320-7102), Sept.-Oct. 1989, pp. 108-112. 6 Refs.

A study is made of the multiplex modulation methods used in PZLT (lanthanum-modified lead zirconium titanate) spatial-temporal light modulators (STLM) with optical and electron selection of electrooptic modules. It is shown that, in the dynamic relaxation memory mode, multiplex STLM effectively perform both analog and digital light modulation. In the digital mode, an optical contrast of at least 100:1 is achieved; the analog mode provides stable reproduction of at least eight gray scale tones.

A89-27376 Corrosive-mechanical fracture of silicon nitride ceramics in air (Korroziionno-mekhanicheskoe razrushenie nitridkremnievoi keramiki na vozdukh). I. U. G. GOGOTSI, V. P. ZAVADA, and V. V. TRASKOVSKI, *Fiziko-Khimicheskaiia Mekhanika Materialov* (ISSN 0430-6252), Vol. 24, Nov.-Dec. 1988, pp. 17-21. 10 Refs.

The temperature dependence of the mechanical properties of silicon nitride ceramics and the effect of oxidation on their strength are investigated experimentally using a reaction-sintered silicon nitride ceramic containing 30 percent of silicon carbide and a small amount of boron nitride and magnesium oxide. It is found that, in the temperature range corresponding to the onset of oxidation (600-900 C), the ceramic is susceptible to stress corrosion cracking, which must be taken into account in estimating the performance of such materials. Coatings protecting the material against internal oxidation help preserve the high-temperature strength characteristics of the ceramic.

A90-18114 Effect of the thermal history of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- δ) ($X = \text{Y}$, Eu) ceramic materials on their conducting properties (Vliianie termicheskoi predystorii keramicheskikh materialov $\text{YBa}_2\text{Cu}_3\text{O}$ (7- δ) ($X = \text{Y}$, Eu) na ikh provodiashchie svoistva). I. G. GUSAKOVSKAIA, S. I. PIRUMOVA, A. E. UKSHE, V. V. TKACHEV, and L. O. ATOVMIAN, *Zhurnal Tekhnicheskoi Fiziki* (ISSN 0044-4642), Vol. 59, Oct. 1989, pp. 172-174. 6 Refs.

Specimens of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- δ) and $\text{EuBa}_2\text{Cu}_3\text{O}$ (7- δ) ceramics were investigated by calorimetric and resistometric analyses. In particular, an attempt is made to relate the experimentally observed nonsuperconducting kinetic phase transition in these ceramics to the unstable increase of the superconducting transition temperature from 90 to 130 K. The effect of heat treatments on the stability of the superconducting properties of these ceramics is discussed.

A90-12394 Effect of machining on the durability of ceramic materials (Vliianie mekhanicheskoi obrabotki na dolgozhestnost' keramicheskikh materialov). V. P. TEREENT'EV and S. Z. STASIUK, *Problemy Prochnosti* (ISSN 0556-171X), Sept. 1989, pp. 31-36. 9 Refs.

Four-point bending tests were conducted to investigate the effect of microcracks formed during grinding and polishing operations on the short- and long-term strength of specimens of magnesium-aluminum ferrite with a spinel-like structure. It is shown that the orientation of the cracks relative to the maximum tensile stresses applied to the component during service is an important factor which must be taken into account in order to increase the reliability of ceramic components that have been subjected to grinding.

A89-50947 Effect of the mechanoactivation of components on the physical and chemical properties of superconducting yttrium-barium ceramics (Vliianie mekhanooaktivatsii komponentov na fiziko-khimicheskie svoistva sverkhprovodiashchei ittrii-barievoi keramiki). A. G. LIPSON, S. V. PETROV, V. A. KUZNETSOV, D. M. SAKOV, IU. P. TOPOROV et al., *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 306, June 30, 1989, pp. 1409-1412. 9 Refs.

It is established that mechanoactivation of the initial mixtures of the components of yttrium-barium ceramics leads to the formation of the superconducting orthorhombic phase of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- x) even in the absence of the preliminary annealing of the component mixture. When the regime of preliminary annealing with subsequent vibratory dispersion of the component mixture is applied, a cymbate change in the specific surface, density, and resistance of the specimens occurs which is due to mechanochemical synthesis reactions of yttrium-barium cuprates in the oxide mixture system.

A89-49297 Magnetization and critical currents of ceramic semiconductors (Namagnichivanie i kriticheskie toki keramicheskikh sverkhprovodnikov). IU. I. KUZ'MIN and I. V. PLESHAKOV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, June 12, 1989, pp. 30-35. 7 Refs.

Specimens of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- δ) superconducting ceramic produced under different process conditions were investigated experimentally to determine the field dependences of the critical currents and pinning forces during magnetization. Magnetization curves were obtained in the form of hysteresis loops of two types. One type is adequately described by the Bean-London critical state model, while the second type can be adequately described by considering the field dependence of the critical current. The presence of strong pinning is confirmed.

A89-49223 Effect of direct current on the microwave response in the HoBaCuO high-temperature superconducting ceramic (Vliianie postoiannogo toka na SVCh otklik v vysokotemperaturnoi sverkhprovodiashchei keramike HoBaCuO). G. A. PETRAKOVSKII, G. S. PATRIN, IU. N. USTIUZHANIN, K. A. SABLINA, and G. N. STEPANOV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, May 26, 1989, pp. 70-74. 5 Refs.

Experiments were conducted on the $\text{HoBa}_2\text{Cu}_3\text{O}$ (7- y) superconducting ceramic to determine the effect of direct current on the microwave response of the superconductor. Signal intensity was found to decrease with increasing current. Observed changes in the microwave power depend on the magnitude and direction of the current. The response of the specimen to the direct current under microwave irradiation appears to suggest the Josephson nature of the radiation/matter interaction. The back effect of microwave radiation on the current state of the specimen was also investigated.

A89-40519 Superplasticity of the ceramic compound $\text{YBa}_2\text{Cu}_3\text{O}$ (7- x) (Sverkhplastichnost' keramicheskogo soedineniia $\text{YBa}_2\text{Cu}_3\text{O}$ (7- x)). O. A. KAIBYSHEV, R. M. IMAEV, and M. F. IMAEV, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 305, No. 5, 1989, pp. 1120-1123. 6 Refs.

The possibility of achieving the superplastic transition in $\text{YBa}_2\text{Cu}_3\text{O}$ (7- x) ceramic is investigated experimentally in an effort to find ways to improve the processability of this promising superconducting material. It is found that during the deformation of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- x) in the temperature range 900-950 C at a rate of 0.0001/s, superplastic deformation is achieved after dynamic recrystallization. A similar sequence of dynamic recrystallization and superplastic deformation is observed (although at lower homologous temperatures) during the hot deformation of metals and intermetallics.

A89-44849 The microwave resistance of $\text{YBa}_2\text{Cu}_3\text{O}$ (6.9) ceramic (Mikrovolnovoe soprotivlenie keramiki $\text{YBa}_2\text{Cu}_3\text{O}$ (6,9)). V. F. GANT-MAKHER, V. I. KULAKOV, G. I. LEVIEV, R. K. NIKOLAEV, A. V. POLISSKII et al., *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0044-4510), Vol. 95, April 1989, pp. 1444-1449. 12 Refs.

The temperature dependence of the microwave resistance of a ceramic at a frequency of 17.6 GHz is measured using a cavity made entirely of $\text{YBa}_2\text{Cu}_3\text{O}$ (6.9). An empirical formula which satisfactorily describes the $R(T)$ dependence (where R is the surface resistance) below the superconducting transition temperature is proposed. It is shown that the strong $R(T)$ dependences observed at T less than T_c are in agreement with measurements of the penetration depth.

A89-42526 Radio frequency size effect near T_c in high-temperature superconductors (Radiochastotnyi razmernyi effekt vblizi T_c v vysokotemperaturnykh sverkhprovodnikakh). E. V. IZHAK, A. IA. KIRICHENKO, IU. F. REVENKO, V. M. SVISTUNOV, and N. T. CHERPAK, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, April 12, 1989, pp. 1-5. 6 Refs.

The high-frequency absorption characteristics of $\text{YBa}_2\text{Cu}_3\text{O}$ (7- δ) ceramic specimens 2.13 and 3.63 mm thick were investigated in the frequency range 1-10 MHz at 300-77 K with a view to determining the physical mechanisms of the singularities in the temperature dependence of high-frequency absorption observed experimentally in such ceramics. Based on the results obtained, the observed minimum in the temperature dependence of the Q factor in the superconducting transition region is explained in terms of the radio frequency size effect in the case where the skin layer depth is equal to the specimen thickness. This phenomenon is similar to the effect observed in a normal metal during changes in a static magnetic field.

A89-40695 Neutron diffraction studies of the structure of Y-Ba-Cu-O-CI ceramics (Neitronograficheskie issledovaniia struktury keramiki Y-Ba-Cu-O-CI). IU. A. OSIP'IAN, E. L. BOKHENKOV, I. V. GOLOSOVSKII, O. V. ZHARIKOV, A. V. KRASHENINNIKOV et al., *Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0370-274X), Vol. 49, Feb. 25, 1989, pp. 214-218.

Specimens of chlorinated rhombic and tetragonal Y-Ba-Cu-O ceramics were examined by neutron diffraction analysis at a neutron wavelength of 1.384 Å. Three phases, one amorphous and two crystalline, were identified in the ceramic specimens, which became superconducting following chlorination. It is shown that chlorine atoms are incorporated into the elementary cell. It is further shown that chlorine atoms are statistically substituted for oxygen atoms rather than occupying free sites.

A89-40648 High-temperature behavior of a hot pressed boron carbide ceramic. I—Stability against oxidation (Povedenie gorjachepressovannoi keramiki na osnove karbida bora pri vysokikh temperaturakh. I—Stoikost' k okisleniu). IU. G. GOLOTSI and V. V. KOVYLIAEV, *Poroshkovaia Metallurgiiia* (ISSN 0032-4795), April 1989, pp. 71-75. 11 Refs.

To investigate the high-temperature oxidation behavior of ceramic materials based on boron carbide, specimens of boron carbide ceramics with additions of aluminum and silicon were heated in air under controlled conditions at 7.5 C/min up to 1430C. It is found that the addition of aluminum and silicon to boron carbide leads to the formation of borosilicate glass. However, homogeneous distribution of the additives in the material is essential for the formation of a continuous protective layer.

A89-40647 Impact fracture of ceramic plates (Udarное razrushenie keramicheskikh plastin). B. A. GALANOV, O. N. GRIGOR'EV, V. V. KARTUZOV, V. I. KOVTUN, V. N. OSTAPENKO et al., *Poroshkovaia Metallurgiiia* (ISSN 0032-4795), April 1989, pp. 63-71. 10 Refs.

A model is presented which describes the fracture of a ceramic plate in a plane shock wave produced by the motion of the plate surface (i.e., the plate surface is treated as the impactor-plate contact surface). The shock wave has a two-front structure, with the elastic forerunner front moving at a velocity approximately equal to the speed of sound within the plate material and the fracture front trailing behind. A procedure for calculating the linear dimensions of the fracture zone and the mean size of the particles of the damaged material is described, and results are presented for SiC and B₄C plates.

A88-26049 Problems and prospects of the development of boron nitride ceramics (Problemy i perspektivy razvitiia keramiki iz intrida bora). L. N. RUSANOVA, A. G. ROMASHIN, G. I. KULIKOVA, and O. P. GOLUBEVA, *Poroshkovaia Metallurgiiia* (ISSN 0032-4795), Jan. 1988, pp. 23-31. 9 Refs.

The current status of boron nitride technology is reviewed. In particular, attention is given to the problems involved in the production of pure ceramics from hexagonal and wurtzite boron nitride associated with the characteristics of the structure and inhomogeneity of the chemical bonds

of elementary crystal cells of different modifications. A new process, referred to as thermal molecular cross linking, is proposed which is based on the use of heteroorganic compounds for the strengthening and oxidation protection of a high-purity porous boron nitride matrix and also as high-efficiency sintering aids. The properties of the ceramic produced by this method are compared with those of the well-known grades of boron nitride ceramic.

A89-38449 The possibility of measuring the absolute temperature of ceramics by the method of laser-induced luminescence (O vozmozhnosti izmereniia absolutnoi temperatury keramik metodom lazerno-indutsirovannoi luminesentsii). V. M. BATENIN, A. L. GOLGER, S. V. KALININ, I. I. KLIMOVSKII, and A. V. MOROZOV, *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 27, Mar.-Apr. 1989, pp. 347-351. 7 Refs.

A method for the remote measurement of the absolute temperature of ceramic surfaces is proposed which is based on determining the temperature dependences of the temporal or spectral parameters of their luminescence induced by the emission of a pulsed UV laser. The method makes it possible to measure the absolute temperature of large surface areas and also the temperature of ceramic surfaces that undergo erosion. The validity of the method is supported by experimental results for refractory ceramics based on MgO, Al₂O₃, ZrO₂·Y₂O₃, CeO₂In₂O₃, ZrO₂In₂O₃, and LaCrO₃ compounds.

A89-38404 Surface resistance of the YBa₂Cu₃O (7-delta) ceramic and its dependence on magnetic field (Poverkhnostnoe soprotivlenie YBa₂Cu₃O(7-delta)/keramiki i ego zavisimost' ot magnitnogo polia). O. A. GOROCHEV, I. E. GRABOI, A. R. KAUL', and V. P. MITROFANOV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, March 12, 1989, pp. 20-24. 7 Refs.

The temperature dependence of the surface resistance of specimens of the high-temperature superconductor YBa₂Cu₃O (7-delta) was measured, and results are compared with those obtained for copper. Also measured was the dependence of the surface resistance of YBa₂Cu₃O (7-delta) ceramic on the magnitude of the external magnetic field at H not greater than 200 Oe at a temperature of 77.3 K. A hysteresis in the surface resistance was observed depending on increases or decreases of the magnetic field.

A89-35660 Finite element method in coupled thermoelectroviscoelasticity problems (Metod konechnykh elementov v svyazannykh zadachakh termoelektroviazkoprugosti). V. G. KARNAUKHOV, V. I. KOZLOV, and V. V. MIKHAILENKO, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 25, Feb. 1989, pp. 19-28. 5 Refs.

A finite element approach is developed for solving physically nonlinear coupled thermoelectroviscoelasticity problems for bodies of revolution under axisymmetric harmonic loading and also for estimating the efficiency of energy conversion and energy dissipation for different oscillatory modes. The oscillations and dissipative heating temperature of viscoelastic piezoceramic bodies are investigated in order to evaluate effects resulting from the interaction between electromechanical and thermal fields and effects associated with the temperature and amplitude dependences of material properties.

A89-35615 Effect of the phase composition and microstructure on the mechanical properties and thermal stability of high-alumina ceramics (Vliianie fazovogo sostava i mikrostruktury na mekhanicheskuu prochnost' i termostoikost' vysokoglinozemistoi keramiki). F. IA. KHARITONOV, E. IA. MEDVEDOVSKII, and I. KH. MOROZ, *Problemy Prochnosti* (ISSN 0556-171X), Feb. 1989, pp. 31-37. 14 Refs.

The mechanical strength and thermal stability of high-alumina corundum-mullite ceramics are investigated as a function of their phase composition and microstructure. In particular, attention is given to the effect of corundum and mullite contents, phase ratio, size and shape of crystals, and closed porosity. It is shown that acicular mullite crystals, which act as a reinforcement, significantly improve the thermal stability of the materials studied; optimal corundum content is 65-75 percent.

A89-35468 Critical power-law behavior of YBa₂Cu₃O (9-delta) metal oxide ceramic (Stepennoe kriticheskoe povedenie metalloksidnoi keramiki YBa₂Cu₃O(9-delta)). IU. M. IVANCHENKO and P. N. MIKHEENKO, *Fizika Nizkikh Temperatur* (ISSN 0132-6414), Vol. 15, Feb. 1989, pp. 135-146. 27 Refs.

A study is made of the superconducting state breakdown in the metal oxide ceramic YBa₂Cu₃O (9-delta). During the transition to the normal state, a critical power-law behavior of the resistance as a function of temperature at a given current and of the voltage as a function of current at a given temperature is observed over a wide range of currents and temperatures. A critical behavior of the diamagnetic moment as a function of temperature for a given intensity of the modulating magnetic field is also reported. A percolation model describing the critical power-law behavior of the resistance, voltage, and diamagnetic moment is proposed.

A89-34113 Observation of superconductivity in a Y-Ba-Cu-O ceramic doped by bromine and iodine (Nabliudenie sverkhprovodimosti v Y-Ba-Cu-O keramike, dopirovannoi bromom i iodom). IU. A. OSIP'IAN, O. V. ZHARIKOV, N. S. SIDOROV, V. I. KULAKOV, G. V. NOVIKOV et al., *Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0370-274X), Vol. 49, Jan. 10, 1989, pp. 61-64.

An observation of the transition to the superconducting (diamagnetic) state in nonsuperconducting tetragonal specimens of YBa₂Cu₃O(6.1) ceramic treated by gaseous bromine or iodine is reported. For specimens doped by bromine at 230 C and by iodine at 450 C, the superconducting transition occurs at 75 and 50 K, respectively; the structure of the ceramic changes from tetragonal to rhombic. The observed effects are attributed to the incorporation of bromine or iodine atoms into the vacant oxygen sites in the plane Cu(l)-O.

A89-38492 Suppression of the superconductivity of high-temperature ceramics in longitudinal and transverse magnetic fields (Podavleniesverkhprovodimosti vysokotemperaturnykh keramik v prodol'nom i poperechnom magnitnom pole). F. G. ALIEV, A. I. BUZDIN, V. A. BALASHOV, V. V. MOSHCHAL'KOV, N. A. KOLOTYRKINA et al., *Fizika Nizkikh Temperatur* (ISSN 0132-6414), Vol. 15, March 1989, pp. 317-319. 7 Refs.

The anisotropy of the superconducting properties and geometrical dimensions of single crystals must lead to the anisotropy of the magnetic resistance of polycrystalline specimens. An experimental observation of this effect near the critical temperature is reported here for a high-temperature superconductor, YBa₂Cu₃O (7-x).

A89-34185 An adaptive deformable mirror with piezoceramic actuators (Adaptivnoe deformiruemoie zerkalo s p'ezokeramicheskimi aktuatorami). V. V. APOLLONOV, A. M. PROKHOROV, S. N. TEMNOV, and S. A. CHETKIN, *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 15, Dec. 1988, pp. 2578-2580. 7 Refs.

The formation of reflecting surface relief by an adaptive deformable mirror was studied experimentally. The effect of the discrete actuators of the adaptive mirror on the reflecting surface was found to be additive. The amplitude and phase-frequency characteristics of the adaptive mirror were determined and its hysteresis and resonance properties were investigated.

A89-34091 Effect of the synthesis temperature on the superconducting parameters of Ti-Ba-Ca-Cu-O ceramic (Vliianie temperatury sinteza na sverkhprovodiashchie parametry keramiki Ti-Ba-Ca-Cu-O). M. F. VERESHCHAK, A. K. ZHETBAEV, A. N. OZERNOI, S. P. SEN'SHIN, A. I. POLIAKOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, Feb. 12, 1989, pp. 20-23.

The superconducting transition temperature of Ti₁B₂Ca₂Cu₃O(x) and Ti₂Ba₁Ca₃Cu₃O(x) ceramics is investigated experimentally as a function of the synthesis temperature. An analysis of the results obtained indicates that the temperature of the superconducting transition and the amount of the superconducting phase in Ti-Ba-Ca-Cu-O systems can be varied in a controlled manner by varying, over a certain range, the temperature of their synthesis. Details of the synthesis procedure and measurement results are presented.

A89-34080 Ceramics in high-temperature gas turbines (Review) (Keramika v vysokotemperaturnykh GTU /Obzor/). I. I. KIRILLOV, A. V. SUDAREV, and A. G. REZNIKOV, *Promyshlennaia Teploekhnika* (ISSN 0204-3602), Vol. 10, No. 6, 1988, pp. 67-87. 80 Refs.

The possibilities afforded by the use of ceramic materials in gas turbines are examined. In particular, it is shown that high thermal efficiency can be achieved in high-temperature ceramic turbines as a result of the almost complete elimination of air cooling requirements. General principles for designing gas turbine components in ceramic materials are formulated. The design-related characteristics of ceramic components and the possibilities of combining ceramic and metal components are discussed. The current status of ceramic gas turbines and future prospects are briefly reviewed.

A89-34044 Softening of a silicon nitride ceramic in air at 700-800 C (O razuprochnenii nitridkremnievoi keramiki na vozdukh pri temperature 700-800 C). G. S. PISARENKO, IU. G. GOGOTSI, V. P. ZAVADA, and V. V. TRASKOVSKII, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 304, No. 5, 1989, pp. 1184-1187. 12 Refs.

A study is made of the mechanical properties and oxidation resistance of a reaction-sintered Si₃N₄ ceramic with SiC and MgO additions. It is shown that a decrease in strength observed in the temperature range 700-800 C results from oxidation-assisted stress corrosion cracking. It is also noted that the activation of corrosion with increasing mechanical stresses in the material is another important aspect of this effect.

A89-27323 Two-flux Bragg-Coulomb mechanism of high-temperature superconductivity (Dvukhpotokovyi bregg-kulonovskii mekhanizm vysokotemperaturnoi sverkhprovodimosti). V. V. KOCHAROVSKII and VL. V. KOCHAROVSKII, *Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0370-274X), Vol. 48, Nov. 25, 1988, pp. 523-527. 7 Refs.

A high-temperature superconductivity mechanism is proposed which is based on the Bragg reflection of electrons from a grid of conducting atomic layers. It is shown that Coulomb repulsion, screened by the layers, leads to high-temperature superconductivity through the formation of two, mutually inducing, counterpropagating fluxes of paired electrons. The two-flux superconductivity mechanism proposed here makes it possible to explain the high-temperature superconductivity of ceramics and indicates a way of creating layered atomic structures with a higher critical temperature.

A88-37541 Description of the thermomechanical properties of some structural materials (K opisaniu termomekhanicheskikh svoistv nekotorykh konstruktivnykh materialov). E. I. STAROVOITOV, *Problemy Prochnosti* (ISSN 0556-171X), April 1988, pp. 11-14. 7 Refs.

The principal nonlinear and rheonomic thermomechanical characteristics of D16T aluminum alloy, nitride-silicon ceramics, and polytetrafluorethylene are determined from the available experimental data. A comparison is made between the calculated values and the experimental data. Details of the calculation procedure are presented.

A88-49492 Thermal expansion of ceramics of the type ZrO_2 - In_2O_3 (Termicheskoe rasshirenie keramiki sistemy ZrO_2 - In_2O_3). A. A. AKOPIAN, B. M. BARYKIN, and G. P. CHERNYSHOV, *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 26, May-June 1988, pp. 504-508. 6 Refs.

Experimental results are presented on thermal expansion of zirconium-indium oxide ceramics of general composition $(x)ZrO_2/(100-x)In_2O_3$, with x between the values of 50 to 90, which were prepared as described by Akopian et al. (1987). Experiments were conducted in a high-temperature high-vacuum dilatometric facility, in the temperature range of 300-1600 K, using a noncontact measurement method. It was found that a complete stabilization of zirconia, with formation of cubic solid solution, was accomplished at 20 mol pct In_2O_3 (i.e., when the value of x was 80). It was also found that the dominant effect in the thermal expansion of the ZrO_2 - In_2O_3 ceramics is rendered by a continuous solid solution of zirconium-oxide rather than by the indium oxide phase, which might be present, depending on its content, in the form of inclusions or as a second continuous phase.

A89-13236 Effect of doping and radiation treatment on the physical properties of transparent PLZT ferroelectric ceramics (Lead Lanthanum Zirconium Titanate) (Vliianie legirovaniia i radiatsionnoi obrabotki na fizicheskie svoystva prozrachnoi segnetokeramiki TsTSL). G. ZH. GRINVALDS, V. I. DIMZA, S. S. DINDUN, A. E. KAPENIEKS, A. N. RUBULIS et al., *Avtometriia* (ISSN 0320-7102), July-Aug. 1988, pp. 50-58. 25 Refs.

Specimens of a transparent lead lanthanum zirconium titanate (PLZT) ferroelectric ceramic were doped by transition metal (Mn, Fe, and Co) and lanthanoid (Eu) ions in concentrations up to 1 at. pct and irradiated by electrons and gamma rays. It is found that doping and irradiation produce changes in the structural, optical, and dielectric characteristics of the material which vary with the nature of the dopant and the type of ionizing radiation. The results are interpreted in terms of various ion implantation and vacancy redistribution mechanisms.

A89-21669 High-temperature superconductivity in multiphase ceramic specimens of the Bi-Ca-Sr-Cu-O system (Vysokotemperaturnaia sverkhprovodimost' v mnogofaznykh keramicheskikh obratsakh sistemy Bi-Ca-Sr-Cu-O). A. G. MERZHANOV, S. V. LYSIKOV, M. D. NERSESIAN, I. P. BOROVINSKAIA, I. G. MOROZOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 14, Oct. 12, 1988, pp. 1770-1772.

The superconducting transition in multiphase Bi-Ca-Sr-Cu-O specimens was investigated on the basis of dc (10 mA) resistance measurements. Also investigated was the temperature dependence of the susceptibility, measured on the basis of the change in the Q of a coil with the specimen at a frequency of 30 MHz. It is concluded that most of the tested specimens possessed superconductivity at a transition temperature above the liquid-nitrogen boiling point.

A88-29854 Observation of possible localization effects in metal oxides by the electron tunneling method (Nabludenie vozmozhnykh effektov lokalizatsii v metalloksidakh metodom elektronnoho tunnelirovaniia). A. I. KHACHATUROV, M. A. BELOGOLOVSKII, V. M. SVISTUNOV, and V. I. TARENKOV, *Fizika Nizkikh Temperatur* (ISSN 0132-6414), Vol. 14, Jan. 1988, pp. 101-103. 7 Refs.

A giant zero-bias anomaly is identified in the differential conductivity of tunnel junctions based on lanthanum and yttrium ceramics that do not exhibit superconducting properties. The anomaly is attributed to disordering effects responsible for the transition of metal oxides to the normal state. The disordering itself is attributed to the formation of oxygen vacancies during the fabrication of ceramic materials. The presence of the corresponding random potential leads to carrier localization and, consequently, to the Anderson transition to the insulator state.

A89-23680 Thermal shock resistance of a silicon-nitride ceramic (Soprotivlenie nitridkremnievoi keramiki termoudaru). K. A. KAZAKI-AVICHUS, D. B. NARBUTENE, E. N. CHASOVSKOI, A. F. BATURA, and V. G. VEREVKA, *Problemy Prochnosti* (ISSN 0556-171X), Nov. 1988, pp. 57-60. 7 Refs.

Results of an experimental study of the thermal softening of a reaction-bonded silicon nitride ceramic are reported. It is found that when specimens of the silicon nitride ceramic heated to 400-480 C are submerged into water their strength decreases by a factor of 6-7. The first cracks in the specimens may occur within 0.1 s from the moment they are submerged. No softening is observed in specimens heated to lower temperatures.

A89-18373 SAW screening effect in a layered structure consisting of a ZnO piezoelectric film on silicon (Effekt ekranirovaniia poverkhnostnoi akusticheskoi volny v sloistoi strukture p'ezoelektricheskoi plenki ZnO na kremnii). I. V. BEL'SKII and V. A. OSIPENKO, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 33, Oct. 1988, pp. 2197-2200.

Results are reported on the influence of the screening of the SAW electric component in silicon on the electromechanical coupling coefficient (EMCC) of a ZnO/Si structure. Experimental results are presented on the dependence of the EMCC on the ratio of film thickness to SAW length. The design of a SAW filter using the results presented is discussed.

A89-10793 Investigation of high-temperature superconductivity in Ti-Ba-Ca-Cu-O ceramic (Issledovanie vysokotemperaturnoi sverkhprovodimosti Ti-Ba-Ca-Cu-O-keramik e). B. B. BOIKO, A. I. AKIMOV, V. I. GATAL'SKAIA, S. E. DEM'IANOV, A. L. KARPEI et al., *Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki* (ISSN 0370-274X), Vol. 48, July 25, 1988, pp. 103-105. 6 Refs.

Stable and reproducible results on the high-temperature superconducting ceramic $Tl(1.4)BaCaCu(1.5)O(y)$ synthesized under various conditions were obtained. The highest transition temperature obtained in this system was 125.3 K. It is concluded that the one-step fabrication technique provides for significantly higher values of transition temperature than the twostep technique.

A88-49480 Structure of an AlN-SiC ceramic (Struktura keramiki sistemy AlN-SiC). V. A. MEL'NIKOVA, V. K. KAZAKOV, and A. N. PILIANKEVICH, *Poroshkovaia Metallurgiiia* (ISSN 0032-4795), June 1988, pp. 100-105. 8 Refs.

The structure and mechanical properties of a hot-pressed composite ceramic based on AlN and SiC are investigated experimentally, with the mass content of the two components varying from 10 to 90 percent. It is found that many of the strength characteristics of the ceramic are higher than those of the individual components. The effect of hardening in the system AlN-SiC is explained by the formation of a disperse structure, alternation of phases of varying microplasticity, and substructural characteristics of the ceramic.

A88-36074 Anomalies of the electrical resistance of a Y-Ba-Cu-O ceramic (Anomalii elektrosoprotivleniia keramiki sistemy Y-Ba-Cu-O). B. B. BOIKO, A. I. AKIMOV, V. I. GATAL'SKAIA, S. E. DEM'IANOV, L. A. KUROCHKIN et al., *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 65, Feb. 1988, pp. 402-404. 9 Refs.

Ceramic specimens of the system Y-Ba-Cu-O have been synthesized which, in addition to the typical superconducting transitions at 90-100 K, exhibit an anomalous behavior at higher temperatures. The anomalies of the temperature dependence of the electrical resistance of $Y_1Ba_2Cu_3O$ (gamma) ceramic specimens observed at about 200 K need to be further investigated to identify the phases involved. The temperature dependences of the electrical resistance of the ceramic are shown graphically.

Japanese Aerospace Literature This month: *Ceramics*

A90-35942 High density silicon carbide-carbon ceramics. K. KIJIMA, T. UETSUKI, and K. TANAKA, *Proceedings of the 1st MRS International Meeting on Advanced Materials*, Tokyo, Japan, May 31-June 3, 1988, Vol. 5 (A90-35926 15-27). Pittsburgh, PA, Materials Research Society, 1989, pp. 101-106. 9 Refs.

Consideration is given to the plasma sintering conditions needed to make highly densified silicon carbide containing a great deal of free carbon. It is expected that high density SiC-C ceramics should have high performance properties such as low friction and low electrical resistance. An experiment to produce high density SiC-C ceramic is reported. The plasma sintering apparatus and plasma sintering process used in the experiment are described. The characteristics of the plasma sintered SiC and commercially available SiC heater are compared, showing that the increase in carbon produces an increased Vicker hardness and fracture toughness values.

A90-35933 Cyclic fatigue behavior of ceramics under rotary bending. H. N. KO, *Proceedings of the 1st MRS International Meeting on Advanced Materials*, Tokyo, Japan, May 31-June 3, 1988, Vol. 5 (A90-35926 15-27). Pittsburgh, PA, Materials Research Society, 1989, pp. 43-48. 20 Refs.

Results are presented from rotary bending tests on sintered Al_2O_3 and Si_3N_4 at room temperature. Results from a rotary bending fatigue machine are compared with the static bending strengths obtained from a nonrotating fatigue machine. The fracture surfaces after the tests, the fatigue limit, the character of rotary bending strength, and the fracture features of fatigue are examined. It is found that the life of each material increases as the stress amplitude decreases. Also, the fracture surfaces of Si_3N_4 after fatigue and static tests are shown to have mirrors, while those of Al_2O_3 have no mirrors.