ISHM'95 - XIX CONFERENCE OF THE INTERNATIONAL SOCIETY FOR HYBRID MICROELECTRONICS, POLAND CHAPTER, Porąbka-Kozubnik, Poland 17-20/09.1995

S. Achmatowicz [1], M. Jakubowska [1], A. Marczak [1], I. Tebenko [2]

[1] Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

[2] Institute of Materials, RPA "Karat", Lvov, Ukraine

INVESTIGATION ON RUTHENIUM BASED RESISTIVE PASTES FIRED AT LOW TEMPERATURE

The aim of this work was to obtain resistive pastes fired at low temperature, e.g. 760°C. It was believed that in comparsion to the pastes fired at 850°C, the resistive pastes perform much better when situated on top of a conventional crossover (multi-layer) dielectric layer. Such pastes were obtained by the introduction of new types of glasses to the resistive pastes composition.

This paper shows that resistive pastes printed on an added dielectric layer and fired at 760°C are advantageous indeed.

The behaviour of resistors made of the newly developed resistive pastes has been compared with resistors made of series R-340 (ITME). All the pastes were printed onto standard 96% alumina substrates and onto alumina substrates covered with a dielectric layer, and then fired at temperatures ranging from 700 to 850°C. Thus obtained resistors were evaluated by X-ray (micro-)analysis, SEM, measurements of sheet resistivity and temperature coefficient of resistance, before and after exposure to different environmental conditions (humidity, thermal shocks, voltage pulses, etc.).

Materiał prezentowano na sesji posterów.

II INTERNATIONAL SCHOOL AND SYMPOSIUM ON PHYSICS IN MATERIALS SCIENCE: SURFACE AND INTERFACE ENGINEERING, Jaszowiec, Poland 17-23/09.1995

K. Mazur. J. Sass, I. Pracka

Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

THE X-RAY TOPOGRAPHY INVESTIGATION OF DEFECTS IN ERBIUM AND THULIUM DOPED $LiNbO_3$

Lithium niobate is a material of unusual ferroelectric, optical acoustic and piezoelectric properties used in electronic and laser technology. Recently crystals of better perfections and new interesting properties are obtained introducing rare earth dopants.

In the present work the investigations of lithium niobate crystals doped with erbium and thulium were performed using X-ray Lang topography as the main method of characterization. The microscopic observation of etch patterns were also performed. It was stated that crystals with erbium concentration close to 0,24% contained low density of dislocation and other defects on the level of $10^2/cm^2$. In this case it was possible to perform identification of dislocations using Lang method. A number of dislocations have been indentified on the base of topographs 2n reflections from sets of equivalent lattice planes e.g. $(\bar{2}110)$, $(1\bar{2}10)$, $(11\bar{2}0)$, $(1\bar{1}02)$, $(\bar{1}012)$, $(01\bar{1}2)$ The present topographs revealed also certain concentration of small precipitates and in some cases a boundary of ferroelectric domains. Besides the dislocations and domains boundaries were revealed by selective etching.

$LiNbO_3$ crystals doped with thulium contained lower density of dislocations in comparision with undoped $LiNbO_3$, specially on the $LiNbO_3$: 0,6% at Tm sample - but there were more precipitates and even twins. The direction of twin deformation and the main twin boundary of such twins were established by means of X-ray diffraction topography. The lowest density of dislocations we noticed in the $LiNb0_3$ doped with erbium and thulium simultanously. But the growth striations and some precipitation in the central part of samples have been observed.

Materiał prezentowano na sesji posterów.

II INTERNATIONAL SCHOOL AND SYMPOSIUM ON PHYSICS IN MATERIALS SCIENCE: SURFACE AND INTERFACE ENGINEERING, Jaszowiec, Poland 17-23/09.1995

A. Wehr [1], A. Rylski[2]

[1] Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

[2] Institute of Materials Engineering, Technical University of Łódź
ul. B. Stefanowskiego 1/15, 90-924 Łódź, Poland

PENETRATION ANALYSIS OF ELEMENTS IN LAYERED POLYCRYSTALLINE FILMS OF Ni-Ag AND Ni-Cu-Ag

Previous research [1] has shown that copper introduced into the silver-nickel interfacial region facilitates the formation of the interfacial joints that are created during manufacturing of Ag-Ni contact material. The paper presents the depth distributions of each element in the Ni-Ag and Ni-Cu-Ag structures, before and after annealing. The depth distributions were obtained by Auger Electron Spectroscopy (AES). These AES studies are an extension of previous research [2].

It has been discovered that microstructure will critically affect interphase boundary formation when copper is introduced into the Ag-Ni interfacial region. Copper mainly diffuses into the nickel and not into the silver. The shape of the copper concentration profile is influenced by the grain size of nickel. Therefore the concentration profile is dependent on which type of diffusion is dominant, the grain boundary or the volume. The diffusion-type interphase boundary has not been observed in the silver-nickel binary system.

[1] J. Kowalczyk, A. Wehr: On the formation of interphase boundaries of diffusion type as a method of improving interfacial adhesion in Ag-Ni composite contact material. Proc. of the 17th Int. Conf. on Electrical Contacts. Nagoya Japan,(1994), pp. 545-552.

[2] A. Wehr, A. Barcz: Atomic transport in layered polycrystalline films of Ni-Ag and Ni-Cu-Ag. J. Mat. Sci. Let. 12 (1993) 1920.

Materiał prezentowano na sesji posterów.

II INTERNATIONAL SCHOOL AND SYMPOSIUM ON PHYSICS IN MATERIALS SCIENCE: SURFACE AND INTERFACE ENGINEERING, Jaszowiec, Poland 17-23/09.1995

W. Wierzchowski[1)], K. Mazur[1)], Wł. Strupiński[1)], K. Wieteska[2)], W. Graeff[3)]

[1)] Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

[2)] Institute of Atomic Energy, 05-400 Otwock-Świerk, Poland

[3)] HASYLAB DESY, 22603 Hamburg, Germany

INVESTIGATION OF MISFIT DISLOCATION SOURCES IN GaAs LAYERS

The formation of misfit dislocation was studied in MOCVD and CVD epitaxial layers of gallium arsenide grown on substrates from LEC-and HGF-grown crystals, doped with 0.2%-1% of isoelectronic indium. In the central parts of the substrates the dislocation density was reduced below $10^3/cm^2$. Single specimens with specific structure due to cellular growth at high indium concentration were included.

The MOCVD processes were performed both with TBA and arsine as arsenic sources in the temperatures of 530°C and 630°C, respectively. The CVD process was held at the temperature close to 790°C with sixty times higher growth rate.

The samples were topographically examined before and after epitaxial process. Different X-ray topographic method including white beam synchrotron radiation topography were used. The conventional source investigations were performed with Lang transmission topography and the double-crystal spectrometer method. High accuracy double-crystal camera, based on WILD T3 theodolites and automatized using PC-controlled stepper motors, enabled taking a series of topographs with improved control of angular position. This camera was also used for evaluation of lattice parameter with the accuracy of 10^{-6} for evaluation of indium concentration in the substrates.

The aim of the synchrotron investigation was to achieve spatial resolution better than 2 μm and to obtain a complete set of topographs in 220- and 400- type reflections for analysis of dislocation type. The synchrotron topographs were taken in low abosbed 1,26 Å radiation and the large area topographs were obtained by successive exposure of 3 mm narrow strips.

The topographic investigations were supported by the application of simulation of the back-reflection double-crystal images of crystallographic defects in epitaxial layers, in particular, of the rading dislocations, misfit dislocation and misfit dislocations crossings.

The deposited layers were in the thickness range 3-5 μm while the critical conditions of misfit dislocation formation required 0.5-2 μm of the epitaxial deposit. The density of misfit dislocation was relatively low enabling the dislocation in the substrate originating in them to be followed. It was found that only a part of the observed misfit dislocations was formed from the dislocations preexisting in the substrate, and a larger number was caused by imperfections in epitaxial deposit. On the other hand a significant number of threading dislocations did not produce misfit dislocations segments despite a suitable glide system, as it was identified using the numerical simulation.

A good crystallographic quality of MOCVD-grown layers was confirmed by the visibility ct the individual defects in the double-crystal topographs and by a relatively small broadening of the rocking curves.

The work was sponsored by The State Committee for Scientific Researches (KBN) (grant. no. 1130/95).

Materiał prezentowano na sesji posterów.
Pełny tekst opublikowany będzie w: Acta Physica Polonica.

II INTERNATIONAL SCHOOL AND SYMPOSIUM ON PHYSICS IN MATERIALS SCIENCE: SURFACE AND INTERFACE ENGINEERING, Jaszowiec, Poland 17-23/09.1995

K. Wieteska [1], K. Dłużewska [1], W. Wierzchowski [2]

[1] Institute of Atomic Energy, 05-400 Otwock-Świerk, Poland

[2] Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

LATTICE DEFORMATION STUDIES IN SILICON IMPLANTED WITH HIGH-ENERGY PROTONS

The deformation of crystal lattice in silicon due to high-energy proton implantation and additional thermal treatment was studied by means of X-ray diffraction and optical control of surface layer bending.

The examined samples were prepared from dislocation free silicon implanted with protons at energy range 1.6 - 9 MeV and doses 2 x 10^{17} - 5 x 10^{17} cm^{-2}. The investigation was performed on as implanted samples and also on those after thermal and electron annealing.

The determination of lattice deformation was based on double-crystal topography and rocking curve measurements. The experiments were performed at different double-crystal spectrometer settings both with CuK_a and MoK_a radiations. The series of topographs were taken at different angular positions of the sample. The surface relief of the implanted part of the crystal was also revealed taking the optical picture of the grid in the beam reflected from the surface.

The implantation caused a significant deformation of implanted wafers even at the thickness exceeding 1.6 mm. A hat-shaped circular bending of the whole sample was observed beeing convex at the implanted side. Thermal and electron beam annealing caused a dramatic increase of the deformation in the implanted part due to amorphisation of the destroyed layer while the bending of remaining part of the sample was reduced.

A characteristic behaviour of double-crystal topographic contrast was observed in the thermally processed samples where the implanted area showed a bean-shaped very sharp narrow contour. The shape of this contrast and its dependence on the angular position was simulated with a resonable accuracy assuming that the crystallographic planes parallel to the surface are bent along the Gaussian profile.

Materiał prezentowano na sesji posterów.
Pełny tekst wydrukowany będzie w: Acta Physica Polonica.

II INTERNATIONAL SCHOOL AND SYMPOSIUM ON PHYSICS IN MATERIALS SCIENCE: SURFACE AND INTERFACE ENGINEERING, Jaszowiec, Poland 17-23/09.1995

K. Wieteska[1)], W. Wierzchowski[2)], W. Graeff[3)]

[1)] Institute of Atomic Energy, 05-400 Otwock-Świerk, Poland

[2)] Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

[3)] HASYLAB DESY, 22603 Hamburg, Germany

INVESTIGATION OF IMPLANTED LAYERS BY MEANS OF BACK-REFLECTION AND TRANSMISSION SYNCHROTRON SECTION TOPOGRAPHY

The synchrotron section topography realized both in transmission and back-reflection geometry was applied for investigation of silicon implanted with 4.8 MeV α-particles and 1,1.6 and 9 MeV protons. The purpose of the section experiments was the direct localization of the destroyed layer and the evaluation of its thickness.

The experiments were performed with DORIS III synchrotron source using white beam limited by 5 μm slit. A number of section topographs in different reflections were taken.

The Bragg-case section topographs revealed a characteristic patterns caused by layer structure in the sample. A number of maxima due to shot-through layer, the substrate and the deformation field in the vicinity of the destroyed layer was observed. This pattern was changed in different reflections but it was directly dependent on the energy of the implanted ions. The contribution from the destroyed layer was usually of direct character and was reflected at a slightly different angle than the

other part of the contrast. The correspondence of the experimental pattern and the theoretical one obtained by numerical integration off Takagi-Taupin equation was achieved.

In the case of the samples implanted with the ions of lower energies the transmission section topographs exhibited slightly deformed Kato fringes and additional strong interference contrasts coming from the implanted region. The samples bombarded with 9 MeV protons produced a very distinct moire fringes due to interference of the beams diffracted by two parts of the crystal separated by the destroyed layer.

Materiał prezentowano na sesji posterów.
Pełny tekst wydrukowany będzie w: Acta Physica Polonica.

TMC'10th INTERNATIONAL CONFERENCE ON TERNARY AND MULTINARY COMPOUNDS, Stuttgart, Germany 17-23/09.1995

M. Drozdowski [1)], A. Pajączkowska [2,3)], D. Kasprowicz [1)], P. Ziobrowski [1)], A. Kłos [2)]

[1)] Institute of Physics, Poznań University of Technology
60-965 Poznań, Piotrowo 3, Poland

[2)] Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

[3)] Institute of Physics, Polish Academy of Sciences
02-668 Warszawa, Al. Lotników 32/46, Poland

STUDY OF THE ELASTIC PROPERTIES OF $SrLaAlO_4$ AND $SrLaGaO_4$ SINGLE CRYSTALS BY BRILLOUIN LIGHT SCATTERING

There has been a considerable interest in the physical properties of strontium lanthanum gallate, $SrLaGaO_4$ *(SLG)* and strontium larnthanum aluminate, $SrLaAlO_4$ (SLA) belong to the family of compounds with the general formula $ABCO_4$, where A = Ca or Sr, B = rare earth element and C = Al, Ga or some transition element. SLA and SLG single crystals are interesting as a substrates for high temperature superconducting thin films from the standpoint of lattice matching and their dielectric properties. Good quality of epitaxial layers requires both crystallographic perfection and appropiate physical properties of substrate material. Crystal structure and some phy-

sical properties of these crystals have been reported recently, but little is known about their elastic properties.

Single crystals of $SrLaGaO_4$ and $SrLaAlO_4$ used in Brillouin scattering experiment were grown by Czochralski method. The compounds crystallize in the perovskite - like structure, space group I/4mmm. They have six independent elastic constants: $C_{11}= C_{22}$, C_{33}, $C_{44} = C_{55}$, C_{66}, C_{12}, $C_{13} = C_{23}$. Their values have not been measured so far.

In this paper we report the elastic constants of SLA and SLG single crystals, which were determined at room temperature by Brillouin light scattering method. In order to investigate the elastic constants of SLA and SLG single crystals different scattering geometries have been used.

Using the values of elastic constants obtained from Brillouin measurements, the phase velocities and energy flux vectors associated with longitudinal (L) and two transverse (T_1 and T_2) elastic waves propagating in different directions in SLA and SLG single crystals have been calculated.

Materiał prezentowano na sesji referatów.
Tekst opublikowano w: Book of abstracts ... .

TMC'10th INTERNATIONAL CONFERENCE ON TERNARY AND MULTINARY COMPOUNDS, Stuttgart, Germany 17-23/09.1995

A. Pajączkowska [1,2)], J. Domagała [2)], A. Gloubokov [1)], R. Jabłoński [1)], A. Kłos [1)]

[1)] Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

[2)] Institute of Physics, Polish Academy of Sciences
02-668 Warszawa, Al. Lotników 32/46, Poland

CRYSTAL GROWTH AND DEFECTS IN $SrLaAlO_4$ AND $SrLaGaO_4$

Formation of the color centers in polycomponent oxide crystals is still discussed in literature. It is known [1] that the formation of 'D' defects depends on preparation, crystal growth conditions and then thermal treatment, however, their nature is not known. To explain their origin and nature detailed investigations should be performed for a chosen group of crystals. Single crystals of $SrLaAlO_4$ (SLA) and $SrLaGaO_4$ (SLG) are considered as promising substrates for the oxide superconductors (LaSrCuO, YBaCuO, HgBaCaCuO). To improve matching between the layers and the

substrate surface the knowledge of the defect structure and its behaviour in different atmospheres and at different temperatures is important.

SLA and SLG belong to a large family of compounds of the general formula $ABCO_4$, where A is Sr or Ca, B is yttrium or a rare earth element and C stands for Al, Ga or a transition element. These compounds form crystals of tetragonal structure belonging to the space group I4/mmm (K_2NiF_4 type). Crystals were grown in nitrogen atmosphere by Czochralski method. To obtain good quality crystals the convex interface bonding by {101} faces and the defined small gradient of temperature have to be used. Crystals were easily colored and green, amber, yellow and colorless crystals were grown. To investigate the defects the crystals were heated in various atmospheres (oxidizing and reducing) at temperature 950°C-1200°C under normal, low and high pressures. The crystal defects were investigated by several methods: structural (powder diffraction, rocking curve, thermal expansion coefficient), optical (absorption, luminescence, Y - radiation Raman spectroscopy), EPR, magnetic and thermal effects (DTA, DSC).

It was found that the morphology of grown crystals depends on ionicity of the crystal (ioniccovalent bonding, A^{2+}/B^{3+}). In the group of $ABCO_4$ compounds of tetragonal structure there exist compounds with various B and C ions, however, the growth of SLA and SLG good quality crystals is limited to a small concentration of these ions as dopants (greater solubility is for B than C ions). Iron and chromium ions deform C-O octahedra and the change of ions valency was observed. Gallium induces defect related to the reduction Ga^{3+} to Ga^{1+}. Colored as well as colorless crystals showed high perfection, rocking curves measured for the (400) reftection was in the range of width of 0.007°-0.008°- However, as grown colorless and light yellow crystals showed lowest density of defects 'D' as well as the endothermic effects observed for color crystals in a - direction at 540K and 460K for SLA and SLG, respectively.

The maximum intensity of 'D' signal for SLA and SLG was observed in EPR spectra in [110] directions and one can conclude that the defects of max. density are created on {110} planes.

In summary it has been shown that the defects in this group of crystals are connected with redox reaction between oxygen and A, B cations of 2^+ and 3^+ valency and the substitution of C cation introduces other defects. The arrangement of ions on the crystal plane plays an important role in the defect structure.

[1] A.Gloubokov, RJabłoński, W.Ryba-Romanowski, J.Sass, A.Pajączkowska, R.Uecker, P.Reiche, J.Crystal Growth.,147, No. 1/2 (1995) 123-129.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Book of abstracts ... .

EUROMAT'95 - THE 4th EUROPEAN CONFERENCE ON ADVANCED MATERIALS AND PROCESSES
Padua/Venice, Italy 25-28/09.1995

Z.M. Librant, W. Olesińska

Institute of Electronic Materials Technology
ul.Wólczyńska 133, 01-919 Warszawa, Poland

FRACTURE BEHAVIOUR OF CERAMICS-METAL-CERAMICS JOINTS

Dense alumina ceramic of 97.5% $Al2O_3$ contents was joined to metals and composite i.e. FeNi42 copper and copper-carbon fibre composite. Joints were produced by means of active brazing technique using AgCul9.SInSTi3 alloy at the temperature of 1193K and vacuum $2 \cdot 10^{-5}$ Tr. Two rectangular ceramic strips measuring 5×5×27 mm each, were brazed on 5×5 mm surface and joined to metallic plate of thickness of 0.3 mm (braze layers were 0.1 mm thick) to form one beam of 54.5 mm length approximately for further mechanical testing. Such prepared samples were then subjected to bending by means of ZWICK testing machine at the loading rate of 0.1 mm/min and strain-stress curve up to rupture was registered. Bending strength of beams of ceramics-braze-ceramics were about 120 MPa. Insertion of metallic plates (pure copper, FeNi42 and copper-carbon fibre composite) into braze layer decreases the bending strength: little or no decrease for copper insert, 10% for FeNi42 and nearly twice for the composite inserts. Strain-stress relations for bending are typical for brittle fracture except of those for copper inserts where some plastic deformation may be observed.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... EUROMAT'95 .

EUROMAT'95 - THE 4th EUROPEAN CONFERENCE ON ADVANCED MATERIALS AND PROCESSES
Padua/Venice, Italy 25-28/09.1995

W.Olesińska [1)], A. Bień [1)], W.K.Włosiński [2)]

[1)] Institut of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

[2] Warsaw Technical University
02-524 Warszawa, ul. Narbutta 85, Poland

EFFECT OF ACTIVITY OF TITANIUM ON THE PROPERTIES OF CERAMICS-TO- METAL JOINTS

Joining of ceramics-to-metal by means of active braze with an addition of titanium is successfully carried out both with oxide and non-oxide ceramics. This is because of the high reactivity of titanium which enhance diffusional processes during bonding. In this paper effect of titanium on the phase composition of transition layer formed on ceramics surface during the joining process, was investigated. Mechanical strength of the produced joints was also measured. A comparison was made between effect of titanium *in statu nascendi* derived from decomposition of titanium hydride and titanium dissolved into AgCuTi2.4 alloy on joining processes of alumina ceramics and FeNi42 alloy. These processes were carried out at 1193K in nitrogen atmosphere having dew point at -70 degrees centigrade and oxygen contents amounting to 10 ppm. Heating time was 20 min, 1 and 2 hours respectively. X-ray diffraction and scanning electron microscopy was applied for determination of phase composition and topography of the fractured joints along the diffusional transition layers. In both causes i.e. titanium *in statu nascendi* and soluted in alloy, several intermetallic compounds (Cu_3Ti, Ni_2Ti, Al_3Ti) and mixed oxides (Cu_3TiO_4, Cu_2Ti_4O) were found in the transition layers. The kinds of the new phases and its XRD lines intensities depends both on the titanium activity and the duration of the process. Extension of the time of heating, especially in case of titanium hydride, gives rise to the formation of new oxide phases. For testing of the mechanical strength of joints rectangular ceramic beams measuring of 5×5×27 mm, were joined together on the 5×5 mm surfaces to form 5×5×55 mm beams, which were then subjected to bending. Bending strength of beams joined only by a braze layer was compared with those joined with an addition of a thin (0.3mm) plate of FeNi42 alloy. Strength of joints bonded by AgCu26Ti2.4 braze is approximately 20 % higher than those bonded by AgCu28 alloy and with ceramics covered by titanium hydride. Within the transition layer produced by using titanium hydride, intensity of XRD lines of intermetallic compounds i.e. Cu_3Ti and Al_3Ti is clearly higher especially after a short time of heating.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... EUROMAT'95 .

EUROMAT'95 - THE 4th EUROPEAN CONFERENCE ON ADVANCED MATERIALS AND PROCESSES
Padua/Venice, Italy 25-28/09.1995

A. Olszyna [1], A. Halska [1], K.J. Kurzydłowski [1], H.Węglarz [2]

[1] Dept. Materials Science and Engineering, Warsaw University of Technology
ul. Narbutta 85, 02-524 Warszawa, Poland

[2] Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

CONTROLLING THE MICROSTRUCTURE OF α-Al_2O_3 CERAMIC COMPOSITES WITH DENSITY GRADIENT

Ceramic materials, including ceramic composites, belong to the group of modern materials designed for advanced technical applications. Among these materials, α-Al_2O_3-based composites with density gradient seem to be very interesting from the point of view of biomedical applications.

The present study was concerned with α-Al_2O_3 ceramic composites characterized by a density gradient. The density varied as a function of distance from the surface of specimens which having a dense core density of about 99 % surrounded by a surface layer of relative density which could be controlled within the range of 24 % to 44 %. The microstructures of the composites were examined using SEM and a mercury immersion porosity meter. Quantitative analysis of the microstructure was carried out using the methods of image analysis and stereology.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... EUROMAT'95 .

EUROMAT'95 - THE 4th EUROPEAN CONFERENCE ON ADVANCED MATERIALS AND PROCESSES
Padua/Venice, Italy 25-28/09.1995

K. Pietrzak

Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

NATURE AND MORPHOLOGY OF THF INTERFACE LAYER IN CARBON FIBRE-COPPER COMPOSITES

Carbon fibre reinforced copper composites seem to be promising materials because of their programmable properties. The methods of production of these materials permit us to modify their mechanical, thermal and electrical properties, which depend not only on the type of the matrix or the type and content of the fibres, but also on the fibre distribution and the microstructure of the fibre-matrix bonds. The decisive factors that determine the properties of a composite are the microstructure of the interface layer and the nature of the fibre-matrix bonds.

This paper presents the results of a study on the carbon fibre-copper composite produced using the volumetric bonding method. The composite was produced at a temperature of about 950°C under a load of 30 M Pa. The process was carried out in vacuum of 1.5×10^{-3} Pa for about 60 min. The average length of the carbon fibres was 1. 5 mm and the diameter was 7 μm. The matrix starting material was copper powder, pure or doped with Cr or Zr. The powder grain size ranged from 40 to 120 μm.

The morphology and the nature of the carbon fibre-copper interface layer were examined by analysing the linear distributions of the elements and by X-ray techniques. The paper presents theoretical considerations based on thermodynamical calculations. The thickness of the interface layer was determined by optical microscopy and also by mathematical analysis.

The paper discusses how the carbon fibre-matrix bond varies with the matrix composition.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... EUROMAT'95 .

EUROMAT'95 - THE 4th EUROPEAN CONFERENCE ON ADVANCED MATERIALS AND PROCESSES
Padua/Venice, Italy 25-28/09.1995

W.K. Włosiński [1),2)], D. Kaliński [2)]

[1)] Warsaw University of Technology
ul.Narbutta 85, 02-524 Warszawa, Poland

[2)] Intitute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

MICROSTRUCTURE OF THE PHASE LAYER IN AN Al_2O_3-FeNi42 ALLOY JOINT USING AN Ag-Cu/CARBON-FIBRES COMPOSITE FILLER

One of the techniques employed in bonding oxide ceramics with metals and their alloys is brazing. In our earlier studies we have shown that by the use of composite fillers (such as e.g. Ag-Cu alloy/carbon fibres) the shear strength of the bond can be increased by about 60%.

Fillers composed of the Ag-Cu alloy reinforced with carbon fibres belong to the group of materials whose properties can be programmed. Their properties depend on the technology employed, on the matrix composition, the shape (in particular the length) of the fibres, the fibre content, distribution and the microstructure of the fibre-matrix interface layer. In the production of ceramic/metal joints, the properties of the filler are very important, since they determine the structure of the ceramic/metal interface layer and, thus, the overall strength of the joint.

The paper presents the results of experiments on brazing Al_2O_3 ceramics with the FeNi42 alloy using an Ag-Cu-In Ti based-composite filler doped with various amounts of carbon fibers. The variation of the microstructure of the Al_2O_3-FeNi42 interface layer with the carbon fibre (1-2 mm long and 7 μm in diameter) content is discussed.

The brazing process parameters were: T=850°C, pressure - $2.66 \cdot 10^{-3}$Pa, load - 0.6 MPa, t=5 min. The filler was composed of 72.5% Ag, 19.5% Cu, 5% In and 3% Ti (wt.%) and 15, 20, 25, 30 vol.% of carbon fibres, respectively. The results of microstructure examinations (linear distributions of the elements) and of the shear strength tests are presented.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... EUROMAT'95.

ZJAZD NAUKOWY POLSKIEGO TOWARZYSTWA CHEMICZNEGO I STOWARZYSZENIA INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU CHEMICZNEGO
Lublin, Poland 25-28/09.1995

D. Pawlak [1),2)], I. Wawer [1)]

[1)] Uniwersytet Warszawski, Wydz:at Chemii, Warszawa

[2)] Instytut Technologii Materiałów Elektronicznych
ul. Wólczyńska 133, 01-919 Warszawa

KRYSTALOCHEMIA I NMR W BADANIU TAUTOMERII N-SALICYLIDENO-2-HYDROKSYANILINY

N-Salicylidenoaniliny są ciekawymi i często badanymi związkami, ze względu na ich różne pochodne będące popularnymi barwnikami używanymi w przemyśle. Obecność dwóch grup OH w związku w pozycji orto spowodowała, że jest to bardzo dobry model do badania wewnątrz- i międzycząsteczkowych wiązań wodorowych.

Przeprowadzono kompleksowe badania: ^{1}H NMR, ^{13}C CP MAS analizę rentgenowską strukturalną. Widmo ^{1}H NMR w roztworze wskazuje istnienie dwóch grup OH, drastycznie różniących się przesunięciami chemicznymi. Swiadczy to o zaangażowaniu jednej z tych grup w silne wiązanie wodorowe (wewnątrzcząsteczkowe ?).

Widmo ^{13}C CP MAS wskazało, że wartości przesunięć chemicznych nie są typowe ani dla węgla grupy C-OH, ani C=O. Wskazuje to na istnienie dwóch tautomerów, których przesunięcia chemiczne są uśrednione przez szybki transfer protonu.

Analiza rentgenowska strukturalna pokazuje, że cząsteczki badanego związku występują jako tautomer z lokalizacją protonu na atomie azotu. Jednym z potwierdzeń znaczenia większego udziału wyżej wymienionej struktury tautomerycznej w krysztale jest wyraźna różnica w aromatyczności obu pierścieni benzenowych. Zaobserwowano również występowanie dość silnych międzycząsteczkowych wiązań wodorowych O-H...O (w które oba tleny cząsteczki zaangażowane są w różnym stopniu) i wewnątrzcząsteczkowego wiązania wodorowego N - H...O.

Materiał prezentowano na sesji posterów.
Tekst został opublikowany w materiałach z konferencji.

JISSE'4 - 4th JAPAN INTERNATIONAL SAMPE SYMPOSIUM Tokyo, Japan 25-28/09.1995

J. Kapelewski

Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

A PROSPECTIVE ROLE OF SUBSURFACE NON-CENTRAL IMPURITY SYSTEMS IN FORMING A USEFUL HIGH FREQUENCY SAW SUBSTRATE

The paper is concerned with a unique impurity-stimulated way to produce desirable local changes in material properties of some dielectric surfaces by using impurities of a structured adiabatic potential, to locally induce, in the near surface region,

a controllable microdistortion pattern. The physical basis lies in employing of triggering properties of impurity systems, having a multi-well or displacive type potential, to initiate structural changes of a determined symmetry.

The treatment is illustrated in detail with an instructive example of a near-surface system of an harmonic defect centre exhibiting vibronic and piezodistortive coupling with the host lattice.

Materiał prezentowano na sesji referatów.
Tekst opublikowano w: Proceedings ... International SAMPE Symposium.

ECerS'95- FOURTH EURO-CERAMICS SYMPOSIUM
Riccione, Italy 02-06/10.1995

A. Bień [1)], Z. Librant [1)], W. Olesińska [1)], W.K. Włosiński [2)]

[1)] Intitute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

[2)] Warsaw University of Technology
ul. Narbutta 85, 02-524 Warszawa, Poland

EFFECT OF OXYGEN ON THE PROPERTIES OF TRANSITION LAYERS FORMED IN CERAMIC-METAL JOINTS BONDED USING AN ACTIVE BRAZE

The properties of alumina-metal joints produced in atmospheres with various oxygen content were examined and compared. The joints were active brazed in a vacuum of $2 \cdot 10^{-5}$ Tr and also in nitrogen atmosphere with a dew point of -70°C and an oxygen content of 10 ppm. Examinations included the bending strength test performed on small beams loaded at three points, and the thermal shock tests carried out in air within the temperature range from -55 to +155°C. After 25 alternating cycles, the joints preserved their vacuum tightness (the helium leakage did not exceed $1.33 \cdot 10^{-8}$ Pa [$m^3 s^{-1}$]). The transition layers formed in the ceramic-metal joints were examined by means of X-ray diffraction and scanning electron microscopy. It has been found that the transition layers formed in vacuum and in nitrogen differ slightly in their phase compositions. In both the cases, the synthesis of new oxide phases from the Cu-Ti-O system and the Ni_3Ti intermetallic compound were observed to occur.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... ECerS'95.

ECerS'95- FOURTH EURO-CERAMICS SYMPOSIUM
Riccione, Italy 02-06/10.1995

M. Boniecki [1], T. Niezgoda [2]

[1] Intitute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa Poland

[2] Military University of Technology
ul. Kaliskiego 2, 01-489 Warszawa, Poland

THERMAL FATIGUE LIFETIME PREDICTION FOR CERAMIC TOOL MATERIALS

The method of lifetime predictions of ceramic components' subjected to cyclic thermal shocks is presented for example of pin-chucks applied in TV picture tubes production. The attention is paid to some limitation of the method following from the inaccuracy of thermal stress magnitude estimation and strength distribution.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... ECerS'95.

ECerS'95- FOURTH EURO-CERAMICS SYMPOSIUM
Riccione, Italy 02-06/10.1995

M. Boniecki [1], T. Niezgoda [2], W. Szymczyk [2]

[1] Intitute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

[2] Military University of Technology
ul. Kaliskiego 2, 01-489 Warszawa, Poland

NUMERICAL ANALYSIS OF INTERNAL THERMAL STRESSES IN ALUMINA CERAMICS

Finite element method (FEM) was used to calculate internal thermal stresses in alumina ceramics. Two different approaches of boundary and initial conditions for three-dimensional models of orthotropic polycrystalline material were used. The

results of calculations for random orientated axies of orthotropy are given in cross-sectional planes. The results can be used later for producting R-curve desing for noncubic ceramics.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... ECerS'95.

ECerS'95- FOURTH EURO-CERAMICS SYMPOSIUM Riccione, Italy 02-06/10.1995

T. Niezgoda [1)], J. Małachowski [1)], M. Boniecki [2)]

[1)] Military University of Technology
ul. Kaliskiego 2, 01-489 Warszawa, Poland

[2)] Intitute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

NUMERICAL ANALYSIS OF VICKERS INDENTATION ON ALUMINA CERAMICS

Three-dimensional finite element simulation is applied to investigate behaviour of the microindentation process in alumina ceramics. The simulation of the indentation numerical experiment is based on the elastic theory of material deformation. The theory is used to estimate substitutional stress state and energy, which cause the crushing of material during the indentation process. The calculations enable to obtain the distribution and residual stresses during the indentation test.

Materiał prezentowano na sesji posterów.
Tekst opublikowano w: Proceedings ... ECerS'95.

IEEE INTERNATIONAL ULTRASONICS SYMPOSIUM
Seattle, WA, USA 07-10/11.1995

T. Hechner, T. Wróbel

Institute of Electronic Materials Technology
ul. Wólczyńska 133, 01-919 Warszawa, Poland

THE INFLUENCE OF PcCu LAYER CRYSTALLINE STRUCTURE ON THE TEMPERATURE STABILITY OF SAW GAs SENSORS

SAW gas sensors have been the subject of intensive research over the last years. Most SAW sensors are based on a dual-delay-line. In the sensor one of the lines is covered with a chemical coating while the other is used as a reference in order to compensate for the variation of such parameters as temperature, pressure, etc. However, as it follows from the studies of other authors and from our own experiments, the dual-delay-line concept is not an ideal solution to the problem of temperature compensation. As a result the sensor temperature stabilization is often necessary which adds to detection system complexity and cost. It is therefore crucial to search for methods which would increase the temperature stability of gas SAW sensors.In this paper the influence of crystalline structure and geometry of the PcCu coatings on the temperature stability of gas SAW sensors is presented. We constructed dual-delay-line SAW sensors on STX quartz and on 128° YX lithium niobate. Our experiments concerned PcCu coating of α and β structure. We varied the coating layer thickness from 0.1 μm to 1.5 μm and it's density from 0.17 to 1.6 g/cm^3. The temperature stability was investigated in the temperature range from 20 °C to 120 °C. We found out that the temperature stability increases with the decrease of the coating layer mass loading. For both investigated substrates the β-structure PcCu layer gives several times better temperature stability than the α-structure PcCu layer at the same mass.

Materiał prezentowano na sesji posterów.
Tekst został opublikowany w materiałach z konferencji.