

MECHANICAL PROPERTIES OF ZIRCONIA AT CRYOGENIC TEMPERATURE

S. NISHIJIMA^{1*}, S. UENO¹, A. NAKAHIRA², T. SEKINO¹, K. NIIHARA¹, T. OKADA¹ and H. OHNISHI³

¹*ISIR Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka, 567 Japan*

²*Kyoto Institute of Technology, Matsugasaki, Sakyo-Ku, Kyoto, 606 Japan*

³*Nikkato Coop., 3 Orioncho, Sakai, 590 Japan*

Fax: +81-6-875-4342

**email: nishijima@sanken.osaka-u.ac.jp, uenos@sanken.osaka-u.ac.jp*

ABSTRACT

The mechanical properties of yttria doped zirconia(Y-ZrO₂), or yttria doped tetragonal zirconia polycrystal(Y-TZP), have been studied at cryogenic temperatures in order to investigate the applicability of zirconia to cryogenic temperature ranges. The flexural strength together with fracture toughness was found to increase with decreasing temperature. Especially at 4.2K, liquid helium temperature, the flexural strength and/or fracture toughness of zirconia containing 3mole% yttria(3YZrO₂) showed approximately 1.5 times as large as those obtained at 286K. Cooling down to cryogenic temperature, not only increased the Young's modulus but also the expansion of process zone contributed to the increase of fracture toughness of 3Y-ZrO₂.

DIRECT LASER FIRING: A METHOD FOR THE PRODUCTION OF SOL-GEL COATINGS

D. GANZ, G. GASPARRO, A. REICH and M. A. AEGERTER*

Institut für Neue Materialien - INM, Im Stadtwald, Gebäude 43, D-66123 Saarbrücken, Germany
Fax: + 681 302 5249

**email: aegerter@inm.uni-sb.de*

ABSTRACT

The coating technology based on the sol-gel process has revealed a great reliability in industrial application. In this method very homogeneous oxide films are usually prepared by dip or spin coating and afterwards are dried and fired in two separate processes. The high temperature needed for the densification of the coatings, usually around 500°C, and the repetition of the deposition and thermal processes necessary to produce thick coatings are however drawbacks as the speed-limiting factor of the coating process is by far the substrate/coating cooling rate. During the last decade several attempts have been made to overcome these disadvantages by using electromagnetic radiation (EM) such as UV, visible or IR radiation as a densification energy source. In this process the EM radiation is absorbed either in the film or the substrate and converted locally into heat. Taylor et al for example successfully densified silica films prepared with TEOS sol using a CO₂ or a ND:YAG laser. In the last case, as the film and substrate are transparent at the laser emission wavelength, they had to be covered with a metallic layer to get significant optical absorption for the generation of heat. Zaugg et al formed waveguides and Birnie et al multilayer interference filters by scanning a low power laser spot at low speed (up to 2 cm/s) across the surface, resulting in a surface firing speed of 0,2 cm²/s. Arfsten et al claimed that large area flat-glass plates coated with thin sol-gel TiO₂ films can be densified directly by CO₂ laser radiation, with volumetric densities comparable to those obtained in conventional oven process but in a much faster time scale. Other laser techniques requiring either a vacuum or a certain atmosphere to work properly have been reported for large scale coating.

In this work we present preliminary data to fire large substrates at high firing speeds up to 10-15 cm²/s using a continuous wave (cw) CO₂ laser. The process has been applied to electronic conductive transparent sol-gel SnO₂:Sb (5mol%) films. Comparison between laser fired and conventionally furnace fired coatings is addressed.

REACTION BONDED O'-SIALON AND O'-SIALON - SILICON CARBIDE

G. C. BARRIS^{1*}, I. W. M. BROWN¹, T. C. EKSTRÖM¹, G. V. WHITE¹, M. T. COOPER² and G. M. HODREN²

¹*Industrial Research Ltd. P.O. Box 31-310, Lower Hutt, New Zealand
Fax: +64-4-5690117.*

²*Pyrotek Products Ltd., P.O. Box 58459, East Tamaki, Auckland, New Zealand
email: g.barrils@irl.cri.nz

ABSTRACT

A new method has been developed for manufacturing O'-sialon from relatively inexpensive raw materials (silicon, clay and silica). This method has been used to fabricate O'-sialon-SiC composite bodies by reaction bonding. The product exhibits properties, which are similar to those of Si₃N₄-SiC composites, including high strength and excellent corrosion and heat resistance, and it should be suitable for similar applications. The advantages offered by the new process and product are:

- The presence of clay in the raw mixture facilitates forming by slip casting and extrusion. This simplifies the production process and allows greater flexibility in the shape and size of the ceramic components, which can be produced.
- The O'-sialon reaction will go to completion at temperatures as low as 1250°C. This should lead to significant savings on furnace construction and production costs.
- O'-sialon-SiC product appears to be more resistant than Si₃N₄-SiC to attack by molten aluminium and aluminium-magnesium alloy, and to have better thermal shock resistance.

The opportunity exists for making a less expensive, and in some respects, better product than Si₃N₄-SiC, which will be suitable for a range of refractory applications in the aluminium industry.

DIRECT COAGULATION CASTING (DCC) - A NEAR NET SHAPE TECHNIQUE FOR COMPLEX STRUCTURES

M. K. M. HRUSCHKA*, T. J. GRAULE, F. H. BAADER and L. J. GAUCKLER

*ETH Zurich, Department of Materials, Nonmetallic Materials, Swiss Federal Institute of Technology,
Sonneggstrasse 5, CH-8092 Zurich, Switzerland*

Fax: ++41 1 632 11 32

**email: hruschka@nonmet.mat.ethz.ch*

ABSTRACT

In ceramic processing, inhomogenities and mechanical stress in the green body are the main fabrication problems, especially for compact parts with complex geometry. The conventional processing techniques have specific attributes, which promote these inhomogeneities and mechanical stresses and thus limit the applications in case of complex shapes.

Direct Coagulation Casting (DCC) is a new forming technique with the potential to produce parts with complex geometry. DCC uses an aqueous, electrostatically stabilized ceramic powder suspension of low viscosity to which an enzyme-substrate combination was added. This suspension is cast into a non-porous mold, where it coagulates to a stiff, wet green body due to a time delayed decomposition reaction of the substrate.

The coagulation is controlled by the decomposition reaction rate of the substrate into an acid-base combination. This changes the pH and/or the salt concentration of the suspension and neutralizes the electrostatic stabilization. The coagulation time depends on the enzyme concentration and temperature of the suspension. It can be varied from minutes to hours. After coagulation in the mold, the wet green body can be removed, dried and sintered.

TEM OBSERVATION OF MICROSTRUCTURE OF LONGITUDINAL CROSS-SECTION OF AG-CLAD BSCCO SUPERCONDUCTING TAPES

S. X. DOU*, R. K. WANG, M. IONESCU and H. K. LIU

*Institute for Superconducting and Electronic Materials
University of Wollongong, Wollongong, New South Wales 2522, Australia*

Fax: (02) 4221 5730

**email: s.dou@uow.edu.au*

ABSTRACT

The critical current density (J_c) of Ag-sheathed $(\text{Bi,Pb})_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_y$ (2223) and $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_y$ (2212) tape developed using a powder-in-tube technique has reached, at least in laboratory scale, what is required for practical applications. It has been realised that the J_c values of the tapes have a strong correlation with microstructure of the tapes. Numerous studies on microstructures of tapes have been carried out by using XRD, SEM and TEM. The results have revealed that high J_c of tapes is mainly attributable to a strong c-axis texture and the reduced weak links at grain boundaries. On the basis of this microstructural feature, the Brick wall model and the Railway switch model have been proposed to explain the high J_c values and their field dependence in tapes. Both models have a common assumption that J_c is limited by transport current across grain boundaries. However, in the former case the J_c is controlled by the current transport in the c-direction, whereas it is limited by a-b plane transport in the latter case. The tape core consists of many colonies with misorientation angle of about 10° . Each colony consists of a number of individual grains, which share a common c-axis and are connected by twist boundaries. The characteristics of these boundaries and their effect on J_c in tapes have been studied to a certain extent; however there is a lack of consensus on some aspects.

Recently, TEM studies on the microstructures of the broad face and longitudinal cross-section of a large number of tapes with varying critical current density have been carried out. The present work has focused on the study of grain boundaries, colony boundaries and microstructural defects. In particular, valuable information on these aspects has been obtained from the longitudinal cross-section samples of the Ag-sheathed Bi-based 2223 tape.

A STUDY OF THE PROPERTIES OF α -Fe₂O₃-BASED GAS SENSITIVE MATERIAL

J. S. HAN^{1,3}, A. B. YU^{1*}, F. J. HE² and T. YAO²

¹*School of Materials Science & Engineering, The University of New South Wales,
Sydney, NSW 2052, Australia
Fax: + 61 2 385 4429*

²*Department of Physics, Shandong University, Jinan, Shandong 250100, P.R. China*

³*Present address: School of Chemical Technology, University of South Australia, Adelaide,
SA 5095, Australia*

**email: a.yu@unsw.edu.au*

ABSTRACT

Haematite, α -Fe₂O₃, prepared from a solution of iron sulphate or by chemical precipitation from mixed solutions containing quadrivalent metal ions such as Zr, Ti and Sn, has been found to be gas sensitive to combustible gases including CH₄, H₂ and CO. Its gas sensitivity has also been found to decrease as the content of SO₄²⁻ decreases, so it is considered that SO₄²⁻ remaining in α -Fe₂O₃ accounts for its gas sensitivity. Understanding the influence of ions in α -Fe₂O₃ on its gas sensitivity is essential to the successful development of α -Fe₂O₃-based sensors for various applications. This paper reports a study of the properties of α -Fe₂O₃-based gas-sensitive material made from a solution of Fe₂(SO₄)₃²⁻·H₂O and SnCl₄·5H₂O. It will show that the gas sensitivity and selectivity of α -Fe₂O₃ material can be optimised by the proper control of its preparation process.

MATERIAL PROPERTIES OF POROUS SILICON CARBIDE

WOOSUCK SHIN, WON-SEON SEO, KUNIHITO KOUMOTO

*Department of Applied Chemistry, School of Engineering, Nagoya University,
Furo-cho, Chikusa-Ku, Nagoya 464-01, Japan
Fax: +81-52-7893201
email: h951206d@eds.ecip.nagoya-u.ac.jp*

ABSTRACT

Despite of numerous investigations of porous Si, which shows strong visible light emission at room temperature, there is no clear explanation of the luminescence mechanism up to now. This luminescence is attributed to either quantum confinement effect (QCE) of nanocrystallites, or surface effect. Recently, intense electroluminescence (EL) and photoluminescence (PL) have been reported by a few authors to be observed from the porous SiC fabricated by the electrochemical anodization method similar to that employed for porous Si. The electrochemical etching reaction is known to proceed via two stages, in which the oxidation of SiC is followed by the removal of SiO₂ by fluorine ions. This reaction makes the porous silicon carbide (PSC) layer develop into the bulk, whereas the overall profile of the surface in a macroscopic scale remains the same. The luminescence behavior of PSC, however, is somewhat different from that of Si in that the energy of emitted light is lower than the band gap of SiC, and the so-called blue shift is not observed. Though the QCE is said to be responsible for light emission, the surface state of PSC would play also an important role.

In this work, the effects of doping levels varied by the thermal annealing under N₂ atmosphere and the anodization conditions on the microstructures and the luminescence properties were studied. Also the anodization reaction of SiC using HF solution was investigated to understand the formation of PSC. Some spectroscopic analyses were adopted to elucidate the surface chemistry of PSC.

The porous silicon carbide (PSC) was fabricated by a simple method of photo-assisted anodization and showed much efficient luminescent properties than a normal crystal. The microstructure of PSC changed from fibrous to dendritic as the anodization current increased and this was well explained by the rate model of porous structure formation. The most luminescent sample had the dendritic structure which was obtained by only from the substrate of moderately doped crystals. The surface of PSC which seems to be an origin of the luminescence had C-H termination on its surface, and the Si-H or Si-O bonds were not detected. XPS analysis also showed that the Si-O bond existing even on the surface of a usual bulk SiC was depressed and the peak for -CH₂- showed strong peak in the PSC surface. The oxidation treatment reconstructed the Si-O bonds on the PSC surface, but this surface quenched the luminescence.

COMPARATIVE STUDY OF SYNROC CONSOLIDATION METHODS

M. W. A. STEWART*, M. L. CARTER, S. MORICCA, D. S. PERERA, and E. R. VANCE

*Australian Nuclear Science and Technology Organisation (ANSTO),
PMB 1, Menai NSW 2234, Australia
email: mws@ansto.gov.au

ABSTRACT

The aim of the hot consolidation step in Synroc-C processing is to produce a near theoretically dense ceramic composed of the correct phases, having long-term chemical durability and minimal loss of volatile radioactive elements. The relative merits of pressureless sintering, hot uniaxial pressing, hot isostatic pressing, melting and spark plasma sintering of Synroc are discussed, together with the kinetics of hot-pressing.

FINITE ELEMENT ANALYSIS AND THE BEHAVIOUR OF SOL-GEL DERIVED FILMS UNDER ULTRA-MICROHARDNESS INDENTATION

L. GAN and B. BEN-NISSAN*

*Department of Materials Science, University of Technology, Sydney,
P.O. Box 123, Broadway, NSW, 2007, Australia
Fax: 61 2 9514 1628*

**email: Besim.Ben-Nissan@uts.edu.au*

ABSTRACT

Increasing efforts have been directed in the research and development of sol-gel derived zirconia thin films due to zirconia's promising physical and chemical properties. Mechanical properties of thin films are currently measured by micro-indentation. During micro-indentation tests, the film may experience cracking in part due to the stresses developed. Therefore, understanding of the stresses and deformation behaviour in the films during and after indentation has increasingly become an important part of the thin film technology.

The hardness of brittle materials is conveniently measured using a diamond pyramid indenter. However the use of a spherical indenter is usually restricted to tests involving ductile materials. Recently it has been reported that for ceramic materials with a relatively large grain size and weak grain boundaries the characteristic Hertzian cone crack normally associated with loading of a brittle material is suppressed in favour of a region of sub-surface accumulated damage.

Finite element analysis (FEA) has demonstrated to be an effective way to determine the deformation and stresses in thin films under indentation. Studies cover the simulations of indentation with various indenters, Berkovich, cone and sphere. Indentation with spherical indenters has been increasingly used for various materials. One of the reasons for the use of spherical rather than pyramid indenters is to attempt to reduce the stresses in the film that more reliable data can be obtained before cracks are generated.

In this paper, the behaviour of the sol-gel developed zirconia films coated on stainless steel under spherical indentation were analysed using FEA. The stresses within the films under indentation and their variations as a function of the thickness of the film and the mechanical properties of substrate materials were investigated. The features of the distribution of stresses are described.

STRUCTURE AND STABILITY OF SYNTHETIC INTERPHASES IN CMCS

M. G. CAIN*, M. H. LEWIS and P. RIAN

University of Warwick, Coventry CV4 7AL, UK.

Fax: +44 1203 692016

**email: M.G.Cain@warwick.ac.uk*

ABSTRACT

The success of an interphase material for incorporation within oxide-oxide ceramic matrix composites depends largely upon the interphase material possessing the required debonding characteristics and suitable chemical stability at service temperatures. The former requirement can be attained through either maintaining a low bonding adhesion between the interface material and the fibre or matrix or through the materials own intrinsic, and necessarily low, fracture toughness. Materials that possess low intrinsic fracture toughness include porous zirconia and the rare earth (RE) layered β -aluminas. Those that possess an intrinsic low bonding strength with our chosen fibre (alumina) include RE-phosphates. Several instabilities connected with LaPO_4 and spinel, alumina and mullite have been examined and it is the objective of this paper to report on the synthesis of high purity RE-phosphates and their stability with alumina. The alumina is in the form of crushed single crystal sapphire fibres, also the choice of the reinforcement in our CMC studies. The precursor RE-phosphates have been based on both commercially available powders and liquid precursors synthesised at Warwick.

In some earlier work, Morgan produced CMC's based on Saphikon fibres embedded in a LaPO_4 matrix acting as an interface material. These composites were reported stable to at least 1400°C and evidence of debonding was observed as crack arrest at the fibre matrix interface and some sliding of the fibres when subjected to indentation push through testing. High temperature stability was found to depend strongly on the presence of alkali metallic impurities - such as K, Mg, Ca and others - which participate in the reaction and destabilisation of the monazite at a free surface to form La containing β -alumina platelets. The presence of this phase degraded the nature of the interface which substantially alters the debonding characteristics of this system. It was suggested that the reaction between monazite and alumina at 1600°C , to produce β -alumina-magnetoplumbite (BAMP) products, was caused by loss of phosphorous and also encouraged by the presence of monovalent and divalent impurities - e.g. K - which are highly scavenged by the BAMP phase. An additional series of experiments was conducted to fully evaluate these instabilities, which are the subject of this paper, in La and Nd phosphates synthesised via a liquid phase route. The chemical stability associated with RE-phosphates and RE oxides can be sought from the relevant RE-oxide- P_2O_5 phase diagrams. Purity of precursors has been determined to be important but, perhaps of more fundamental importance, is the inherent instability of the stoichiometric RE- PO_4 phase in the presence of excess P ions. The very steep liquidus with increasing P results in the formation of RE-phosphate + liquid phase at temperatures exceeding $\sim 1050^\circ\text{C}$ for the La system and $\sim 1270^\circ\text{C}$ for the Nd system. Such a liquid would inevitably react with alumina to form β -alumina with further destabilisation of the RE phosphate. Furthermore, a *deficiency* in P in the La system also moves the composition into a liquid + solid phase region with a eutectic temperature of $\sim 1580^\circ\text{C}$. This is not the case for the Nd system where such a liquid forming region has not been determined but which is likely to be in excess of 1780°C . The conclusions from this work are that Nd Phosphate is inherently more stable than La phosphate from a thermodynamic argument and with critical control over stoichiometries and precursor homogeneity, stable RE-phosphate/alumina couples can be retained within oxide-oxide ceramic matrix composites.

THE DETERMINATION OF THE COMPOSITION AND THE DEGREE OF HYDRATION OF BLAST FURNACE SLAG BLENDED CEMENTS BY SELECTIVE DISSOLUTION AND CHEMICAL ANALYSIS

R. GOGUEL and N. B. MILESTONE

Industrial Research Ltd. P.O. Box 31-310, Lower Hutt, N.Z.

ABSTRACT

Increased usage of blended cements in mortars and concretes requires specialised tools for analysis of these cements and investigation of the hardening or hydration process. To determine the composition of cements blended with ground granulated blast furnace slag (BFS) one has to measure:

- 1) Concentration of BFS in the original cement
- 2) The degree of hydration of the BFS in hardened paste, mortar and concrete.

Differences in dissolution kinetics were exploited analytically by Demoulian et al. Such separation methods are based on selective dissolution of all hydrates together with unhydrated clinker leaving behind only the unhydrated BFS. Surprisingly, the selective dissolution technique has so far only been used gravimetrically. At best, the gravimetric method is capable only of measuring one parameter: the percentage of unhydrated BFS and this only in cement pastes and not in mortars or concretes. Determination of the degree of BFS hydration also requires prior knowledge of the BFS concentration in the blended cement. This is not necessary when selective dissolution is accompanied by chemical analysis for the major elements. Their partitioning between the two separated phases will, in many cases, provide all necessary information. Analysis of dry cement samples after selective dissolution can also lead to the identification of the source of the cement.

Efforts were therefore concentrated on the development of a consecutive dissolution technique that produces two sets of aqueous solutions ready for analysis by AAS and ICP-OES. Highly alkaline EDTA solutions are capable of complete dissolution of normal portland cement (OPC). Demoulian et al. settled for a carbonate containing sodium-EDTA-TEA solution at pH 11.6 for this purpose. However, some problems remained:

- 1) The rate of dissolution of BFS in Demoulian's solvent is not negligible and precludes separation from OPC when its alkalinity was increased beyond pH 11.6. Even at pH 11.6 some BFS dissolves too fast for good separation, besides, the pH value commonly rises above 11.6 during dissolution of OPC.
- 2) The solubility of silica is too low at pH 11.6, and siliceous precipitates tend to form.
- 3) OPC does not dissolve completely. Solvent resistant Mg-Al-hydroxide phases remain, especially after extensive curing. These are negligible in low magnesium OPC, but not in blended cements where BFS contributes (e.g. 6% in BFS-A). This can introduce major errors into the gravimetric method.

A vast improvement in selectivity for dissolution of OPC can be obtained when sodium is replaced by a much larger cation: tetramethyl ammonium (TMA) and the pH is increased by one unit to provide ample solubility of silica. By the choice of a smaller cation (lithium), another solvent is created that dissolves BFS in a relatively short time. These two solvents permit consecutive dissolution of OPC (hydrated and unhydrated) together with the hydrated portion of BFS, followed by dissolution of the unhydrated BFS.

THE EFFECT OF Si_3N_4 AND AlN ON THE FABRICATION OF LITHIUM-ALUMINOSILICATE OXYNITRIDE GLASS-CERAMICS

ASTRID NORDMANN and YI-BING CHENG

*Department of Materials Engineering, Monash University,
Wellington Road, Clayton Vic. 3168, Australia*

ABSTRACT

Oxynitride glass-ceramics based on the lithium aluminosilicate (LAS) system have been prepared using both Si_3N_4 and AlN as the nitrogen source. Glasses of composition $\text{Li}_2\text{O}\cdot\text{Al}_2\text{O}_3\cdot 4\text{SiO}_2$ were studied to determine their nitrogen solubility, and samples containing up to 4wt% nitrogen were subsequently heat-treated to temperatures $\leq 1200^\circ\text{C}$. The resultant crystallised materials were analysed by x-ray diffraction and solid state nuclear magnetic resonance (NMR) spectroscopy and were found to be comprised, in varying proportions, of β -quartz solid solution, β -spodumene solid solution, X-phase ($\text{Si}_3\text{Al}_6\text{O}_{12}\text{N}_2$) and $\text{Si}_2\text{N}_2\text{O}$. These results are discussed with particular attention given to the thermal stability of β -quartz_{ss} and the different behaviour of Si_3N_4 and AlN as the nitrogen source.

THE TEMPERATURE DEPENDENCE OF THE DIELECTRIC CONSTANT OF A SOFT PZT FOR HYDROPHONE APPLICATIONS

PETER BRYANT

*Thomson Marconi Sonar Pty Limited, 274 Victoria Rd,
Rydalmere, NSW 2116 AUSTRALIA
Fax: 61 2 809 9777*

ABSTRACT

In hydrophone applications, it is important for the piezoelectric ceramic element to have high sensitivity and high capacitance. Lead zirconate titanate (PZT) ceramics are often selected as the material of choice for hydrophones because of their high piezoelectric activity and high dielectric constants. The hydrophone should also be matched with its corresponding amplifier circuitry (either a voltage amplifier or a charge amplifier). Such decisions can influence the selection of the type of PZT required for the application.

For voltage amplifiers ceramic with high "g" voltage coefficient might be preferred. Charge amplifiers require ceramic with high "d" charge coefficients. In addition to the high g or d coefficients, the capacitance of the hydrophone needs to be such as to provide adequate input impedance matching to the amplifier. Depending on the design being used, this can often mean that the device needs a high capacitance and hence high dielectric constant.

The TLZ-5 ceramic produced by Thomson Marconi Sonar is ideal for many hydrophone applications. It has a nominal dielectric constant of 4000 and a high d_{31} charge coefficient of around 300 pC/N. In order to achieve such properties from a PZT, the Curie point is reduced to around 160°C. This means that the dielectric constant of the ceramic is highly sensitive to temperatures. In some cases, the capacitance of hydrophones was found to increase by a factor of two as the temperature increased from 0°C to 50°C. Changes of this magnitude can make impedance matching to the amplifier very difficult. It was therefore decided to look at the temperature variability of the material in more detail.

HYDROTHERMAL OXIDATION OF ALUMINIUM TO α -ALUMINA, BOEHMITE OR THEIR MIXTURES

T. S. KANNAN, P. K. PANDA and V. A. JALEEL

Material Science Division, National Aerospace Laboratories, Bangalore - 560017, India

ABSTRACT

Hydrothermal synthesis yields hydrated or anhydrous powders in a fine crystalline form in a single step. In this process metals or metallic salts react with superheated steam or supercritical water. Nucleation and grain growth of products which take place in simultaneously. Nucleation and growth processes are modified by using additives to control particle sizes and shapes. Hydrothermal synthesis of ceramic oxides like Al_2O_3 , ZrO_2 , HfO_2 , etc., from their salts or from pure metal or alloy powders in sealed gold capsules in a high pressure autoclave is well known. These have the limitations that the quantity synthesised is small and the unreacted starting materials contaminate the product. We describe herein a simple and easy method for hydrothermal synthesis of boehmite, α -alumina, boehmite + α -alumina and spinel + α -alumina composite powder mixtures as well as of chromium, manganese and magnesium doped α -alumina.