INVENTORY OF ON-GOING HIGH TEMPERATURE MATERIALS RESEARCH ACTIVITIES IN EUROPE

SECTION 3: CERAMICS

COMMISSION OF THE EUROPEAN COMMUNITIES
Joint Research Centre, Petten Establishment
High Temperature Materials Information Centre

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Commission of the European Communities

Physical Sciences

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SECTION 3: CERAMICS

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Preface

In the frame of the High Temperature Materials (HTM) Programme of the Commission of the European Communities, carried out at the JRC, Petten Establishment, an Inventory of HTM research in Europe is being established. Inventories facilitate identification of areas where cooperation should be promoted and additional R & D actions be stimulated.

The present volume contains the third of the Inventory, devoted to Ceramics. Further sections are under preparation: Section 4 will deal with Alloy Production and Processing. Section 1: HTM-Corrosion and Section 2: Mechanical Properties*) are already published and are available upon request.

This section comprises information obtained by means of an inquiry carried out in 1982, and by personal communication.
It lists on-going research projects with indication of the performing organisations and the names of the scientists involved in this research.
The list is arranged in alphabetic order per country and organisation. Replies in languages other than English have been translated.
Access to specific research activities is facilitated by indexing per type of materials application/technology, type of material, type of research topic and the involved scientists. Histogrammes of frequencies of research activities are presented in figures 1, 2 and 3 and provides an overview over todays distribution of R & D efforts in the field.

The JRC, Petten Establishment appreciates the willing contribution of all the organisations and scientists who shared in the realisation of this third section and would welcome support for the preparation of future editions.

*) *Inventory of On-Going High Temperature Materials Research Activities in Europe*
Section 1: Corrosion EUR 6919 EN
Section 2: Mechanical Properties EUR 8637 EN

Fig. 1 Frequency analysis of Materials Applications/Technologies

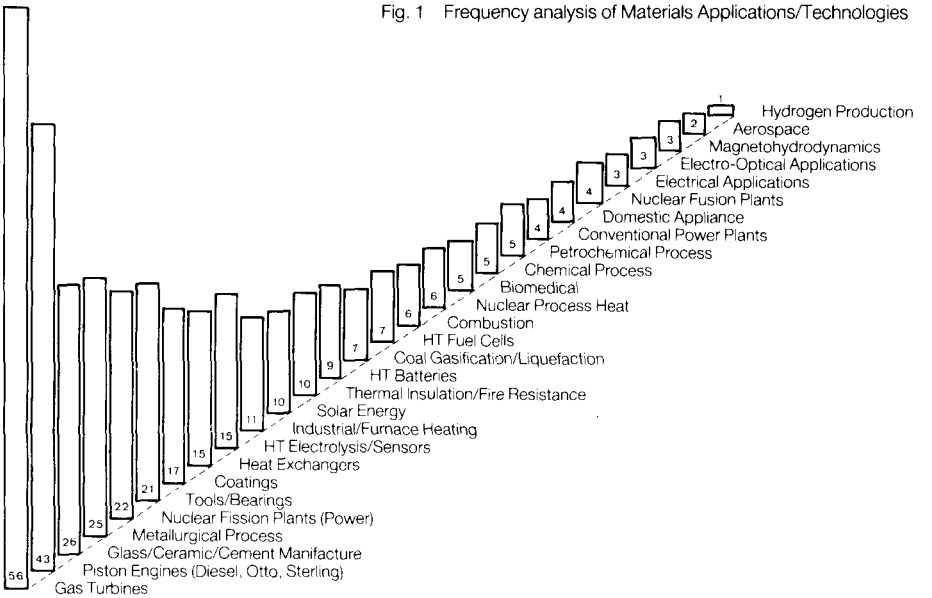


Fig. 2 Frequency analysis of type of Materials

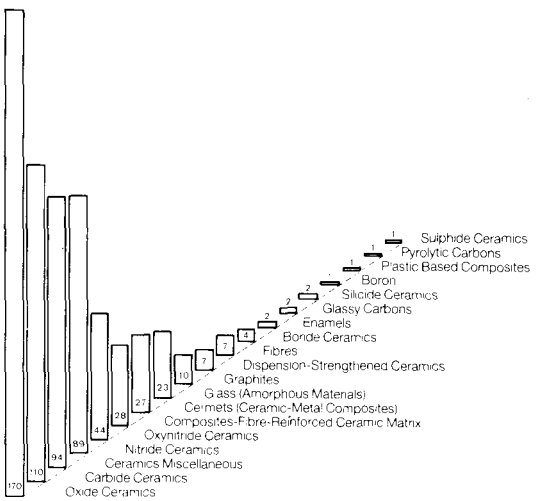
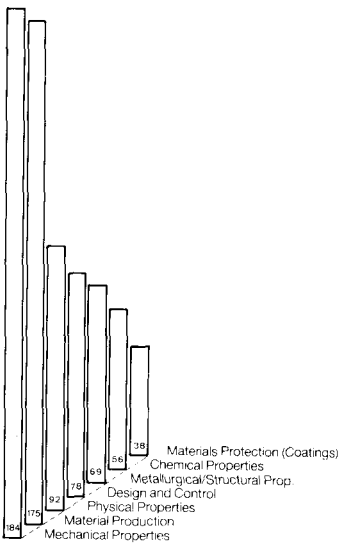


Fig. 3 Frequency analysis of type of Research Topics



Legend

This Inventory presents information on research projects, currently carried out or planned in industrial firms, universities and research organisations in Europe. The information is arranged in alphabetic order per country and organisation.
Example of Organisation Listing (Entry)

SYSTEM	EXAMPLE
Country	DENMARK
Entry Number	14
Name of Organisation	Technical University of Denmark
Name of Dept./Inst.	Department of metallurgy
Address	Anker Engelundsrej 101
City	Dk-2800 Lyngby
Name(s) of scientist(s)	K. Borggreen (1,2)
Project(s)	14.1 Mechanical and high temperature properties of as - cast Hk 40 after 10.000 operating hours
	14.2 Residual lifetime study of low allogned steels Power Stations 14 Mo V6 3; 13 Cro Mo 44

(1) **Technische Universität Wien**
Inst. für Allgemeine Physik
Karlsplatz 13
A-1040 Wien

P. Braun (1)
H. Stori (2)

Project: (1) Study of the surface composition of carbides under ion bombardment

(2) Production of hard layers by physical vapour deposition

(2) **Glaverbel SA**
Centre de Recherches de Jumet
Rue de L'Aurore 2
B-6040 Jumet

J. De Ceuninck (1-2)
J. Della Ruye (2)
P. Robyn (1)

Project: (1) New developments in the repairing of refractories by oxithermal reaction and new application of this process

(2) Improvement of the performances of the fire-proof glazing PYROBEL

---

(3) **Université Cath. de Louvain**
Groupe de Phys.-Chim. et de Cat.
1 Place Croix du Sud
B-1348 Louvain-La Neuve

B. Delmon (1)
J. Lemaitre (1)

Project: (1) Synthesis of very fine grained tungsten carbide with controlled surface properties

---

(4) **Faculté Polytechn. de Mons**
Rue de Houdain 9
B-7000 Mons

H. Vander Poorten (1-3)

Project: (1) Behaviour of refractories in contact with molten silicates

(2) Ceramic to metal bonding

(3) Ceramics for energy applications (electrolytic cells and batteries using high-temperature ion conducting ceramics)

---

(5) **Techn. University of Denmark**
Mineralogical Institute
Building 204
DK-2800 Lyngby

K.G. Jeppeesen (1-2)

Project: (1) Rate Controlled sintering of rawmixes

(2) Preparation of Al_2O_3, ALN, Sialon and SiC by carbothermal reduction of clay

(6) **Helsinki University of Tech.**
Otakaari 1
SF-02150 Espoo 15

K. Lilius (2)
N.H. Taskinon (1-3)
M.H. Tikkanen (1-3)

Project: (1) Corrosion of refractories by PbO containing slags

(2) Corrosion of refractories by molten Na_2CO_3

(3) Corrosion of refractories in copper converters

---

(7) **Tampere University of Technology**
Inst. of mat. science
P.O. Box 527
SF-33101 Tampere 10

P.O. Kettunen (1)
P. Toermaelae (2)

Project: (1) High-temperature ceramic coatings made by CVD, sputtering and plasma spraying

(2) Glassy carbon; preparation and properties

---

(8) **Société Bertin et Cie**
B.P. 3
F-78370 Plaisir

S. Galant (1-3)

Project: (1) Prototype of a new ceramic type gas-gas heat exchanger for utilization at 1500°C (part size: 300 mm; life time of an assembly)

(2) Prototype of a fan for utilization at 1500°C (part size: 300 mm; fatique life at room and elevated temperature, life time of an assembly)

(3) Prototype of a cyclone dust collector for high-temperature gas cleaning (thermal shock; erosion; life time)

---

(9) **C.E.A.-C.E.N. Grenoble**
Dept. de metallurgie/sem
Lab. dev. des Ceramiques
85X
F-38041 Grenoble Cedex

B. Francois (1-4)

Project: (1) Preparation of ultrafine grain ceramics
Strength and wear resistance

(2) Preparation of ceramics with dispersions
Study of their structures

(3) Study of the properties of layers obtained by flame spraying as a function of the powder characteristics

(4) Study of the preparation conditions for cermets with a directional structure

---

(10) **C.E.A.-C.E.N.-Saclay**
DESICP DGI SEPCP SSDP
B.P. 2
F-91191 Gif sur Yvette Cedex

J. Charpin (1-2)
Schnedecker (2)
M. Yvars (1)

Project: (1) Development of refractory materials having good thermal shock resistance and good HT mechanical properties

(2) Calculation & development of plasmasprayed single & multilayer coatings, required HT-qualities: Good thermal shock resistance, adherence and elasticity

---

(11) **C.N.R.S.**
Centre Rech. sur la Physique
des Hautes Temperatures
1D, Av. de la Rech. Scientifique
F-45045 Orleans Cedex

P. Alain (2)
J.F. Baumard (1,4)
F. Cabannes (5,7)
F. Gervais (6)
Ph. Odier (3)

Project: (1) Flash sintering of fine alumina powders

(2) Absorbing and conductive ceramics

(3) Thermo-electronic emissivity and surface defects

(4) Electrical properties and point defects

(5) Thermal conductivity of refractories

(6) Infra-red properties of oxides

(7) Thermophysical properties of fibrous materials

---

(12) **Ceraver**
B.P. 113
F-65001 Tarbes Cedex

L. Minjolle (1-4)

Project: (1) Influence of fabrication and treatment parameters on the strength of ceramics

(2) Determination of the creep and fatique properties at high temperature

(3) Prototypes of heat exchangers with different shapes

(4) Fast methods for the chemical analysis of Si compounds

---

(13) **C.N.R.S.**
Lab. de Physique des Materiaux
1, Place Aristide Briand
F-92190 Meudon-Bellevue

J. Cadoz (1-3)
J. Castaing (2,4)
J. Philibert (4)

Project: (1) High-temperature plastic deformation of a Al_2O_3 single crystals

(2) High-temperature deformation and creep cavitation of polycristalline SiC

(3) In situ study of the plastic deformation of oxides by electron microscopy

(4) Microstructural investigation of ceramic-ceramic composites

---

(14) **Creusot-Loire**
Centre de Recherches d'Unieux
B.P. 34
F-42701 Firminy Cedex

P. Poyet (1)

Project: (1) Thermal insulation, at 800°C, of stainless steel exhaust pipes

---

(15) **ENS de Ceramique Industrielle**
Lab. des Materieux Ceramiques
47-73 Rue Albert Thomas
F-87065 Limoges Cedex

J.L. Besson (2)
P. Boch (3)
J.C. Glandus (1)

Project: (1) Thermal shock resistance of engineering ceramics

(2) Study of the creep of nitride type ceramics

(3) Dispersion - strengthened zirconia base ceramics - Bulk material and plasma coatings

---

(16) **E.N.S. de Chimie de Toulouse**
Lab. de Metallurgie Physique
118 Route de Narbonne
F-31077 Toulouse Cedex

F. Dabosi (1)
B. Pieraggi (1)

Project: (1) Study of the oxidation and of the corrosion of directionally solidified composites

---

(17) **E.N.S. de Mines de Paris**
Centre des Materiaux
B.P. 87
F-91003 Evry Cedex

D. Broussaud (2-9)
A.R. Bunsell (1)
G. Pomey (1-7)

Project: (1) Microstructure and mechanical characteristics of reinforcing fibres

(2) Thermal shock and thermal fatique behaviour of ceramics

(3) Optimization of the industrial process for making reaction bounded silicon nitride

(4) Stability of the thermomechanical properties of partially stabilized zirconia

(5) Study of the improvement of the mechanical properties of ceramics by hot isostatic pressing

(6) Study of the RBSN strengthening

(7) Sub-critical crack growth behaviour of silicon carbide and silicon nitride during static and dynamic fatique tests

(8) Methods of characterizing the rupture behaviour of fibre reinforced ceramic matrix composites

(9) Rolling and sliding wear mechanisms of ceramics

---

(18) **E.N.S. des Mines de Saint-Etienne**
Dept. Materiaux et Ingenierie
158 Cours Fauriel
F-42023 Saint Etienne Cedex

G. Fantozzi (5-10)
Goeuriot (7)
F. Thevenot (1-9)

Project: (1) Study of the boron carbide phase - Relationship between composition and properties
Thermomechanical properties

(2) Study of the hot pressing kinetics of ceramics

(3) Boron nitride-alumina and aluminium nitride-alumina interactions

(4) Hot pressing of zirconium carbide

(5) Sintering behaviour of boron carbide and B_4C-SiC composites

(6) High-temperature mechanical properties of boron carbide and B_4C-SiC composites

(7) Ni-Fe as a substitute for Co in WC tools and boronising

(8) BN-SiO_2 Ceramic-Ceramic Composites

(9) B_4C-SiC Ceramic-Ceramic Composites

(10) Al_2O_3-ZrO_2 Ceramic-Ceramic Composites

---

(19) **Ste. Francaise de Ceramique**
Serv. Refractaire-Analytiques
23 Rue de Cronstadt
F-75015 Paris

H. Le Doussal (1-5)

Project: (1) Flexural strength determination in neutral and/or reducing atmospheres at temperatures up to 1600°C

(2) Toughness of alumina based polyphase ceramics

(3) High-temperature tensile strength of ceramics

(4) Quantitative analysis of silicon metal and silicon compounds in industrial and technical ceramics

(5) Influence of the temperature on the toughness of high-temperature ceramics

---

(20) **I.N.S.A.**
Groupe d'Etudes de Metallurg.
Phys. et de Phys. des Materiaux
20, Ave. Einstein bat 502
F-69621 Villerbanne Cedex

G. Fantozzi (1-6)
N. Rouby (1,7)

Project: (1) Study of the thermal fatique of ceramic materials by acoustic emission and elastic modules determination

(2) Mechanical behaviour of engineering ceramics at temperatures up to 1500°C

(3) Plastic deformation of W_2C at temperatures up to 2200°C

(4) Mechanical behaviour of WC-Co cermets

(5) Determination of the high-temperature creep properties of ceramics

(6) Cavitation in ceramics

(7) Dispersion-strengthened and short fibrereinforced ceramics

---

(21) **LAFARGE Refractaires**
Div. Ceramiques Techniques
2, Av. A. Einstein B.P. 59
F-78193 Trappes Cedex

C. Prats (4)
G. Rancoule (1-3)
J.P. Torre (1-2)

Project: (1) Ceramic utilization in Diesel engines

(2) Application of ceramics in special tools

(3) Nuclear applications of ceramics

(4) High performance ceramic fibres

---

(22) **Lafrage Refractaires**
10, Rue de L'Industrie B.P.1
F-69631 Venissieux Cedex

J.P. Kiehl (1)

Project: (1) Refractories for coal gasification

---

(23) **Soc. Eur. de Propulsion (S.E.P.)**
Lab. de Chimie Materiaux
B.P. 37
F-33165 St. Medard en Jalles

P. Lamicq (1-2)
N. Mace (2)
M. Sauvage (1)

Project: (1) Preparation of ceramic-ceramic composites

(2) Mechanical and thermal properties of ceramic-ceramic composites

---

(24) **Université de Limoges**
Centr. Rech. et Etude Ceram.
123 Rue Albert Thomas
F-87060 Limoges Cedex

M. Billy (6-8)
P. Goursat (4)
J.C. Labbe (2-3)
P. Lefort (1)
J. Mexmain (5)

Project: (1) Preparation of transparent polycrystalline ceramics

(2) Resistance of nitride ceramics to corrosion attack by molten metals and molten salts

(3) Irradiation damages

(4) Influence of thermal treatments on the microstructure

(5) Influence of the environment on the mechanical properties

(6) Structure strengthening by ceramic fibres

(7) Dispersion-strengthened ceramics

(8) Nitrided glasses

---

(25) **Université de Rennes I**
Lab. de Chimie Minérale (LA 254)
Campus de Beaulieu
F-35042 Rennes Cedex

Guyader (2-3)
J. Lang (1-3)
P. Verdier (1)

Project: (1) Study of nitrided glasses

(2) Study of refractory oxynitrides - Preparation of Si_2N_2O and ALN

(3) New Sialons

---

(26) **Batelle Institut EV**
AM Roemerhof 35
D-6000 Frankfurt/M 90

H. Binder (4)
H. Heide (3,10)
U. Hoffmann (1,5,9)
V. Ramakrishnan (8)
W. Schwaemmlein (7)
R. Sherriff (3)
R. Skoutajan (6)
G. Weibel (2)

Project: (1) Possibilities of energy conservation in the ceramic industry

(2) Plasma sprayed coatings as thermal barriers

(3) Hot isostatic pressing of ceramics

(4) Long-life beta alumina electrolyte

(5) Ceramics with controlled porosity for high-temperature applications

(6) High-temperature viscometer

(7) Plasma coated high-temperature (refractory) materials

(8) Core moulding material

(9) High-temperature corrosion resistant ceramic coatings

(10) Ceramic joining by HIP

(27) **Brown, Boveri & CIE-ES**
Eppelheimerstr. 82
D-6900 Heidelberg

W. Fischer (1)

Project: (1) Development of sodium sulphur batteries

---

(28) **C. Conradty Nürnberg GmbH & Co**
Postfach 1752
D-8500 Nürnberg

D. Zollner (1)

Project: (1) Dimension stable combination electrodes for the melting flux electrolysis (together with BMFT/DFVLR KOELN.)

---

(29) **Daimler-Benz A.G. Ebst**
Postfach 202
D-7000 Stuttgart 60

H. Buhl (1-4)

Project: (1) Ceramic parts for gas turbines

(2) Creep and fatique behaviour of ceramics at high temperatures

(3) Development and utilization of ceramic insulators at high temperatures

(4) Ceramic parts for piston engines

---

(30) **DFVLR**
Inst. für Werkstoff-Forschung
Linder Hoehe
D-5000 Köln 90

M. Bohmer (2)
Marci (4)
N. Wirth (3,8)
H.J. Ziegler (1,5-7)

Project: (1) Development of sintered Si_3N_4

(2) Isostatic hot pressing of Si_3N_4 (material development and encapsulation technology)

(3) Crack healing

(4) Fracture mechanics of ceramics

(5) Thermal fatique

(6) Thermal shock

(7) Thermomechanical properties

(8) Influence of protective coatings on the high-temperature strength and creep behaviour

---

(31) **Dornier System GmbH**
Neue Techn. Angewandte Forsch.
Postfach 1360
D-7990 Friedrichshafen

Dietrich (5)
W. Doenitz (4)
Gehrke (1-5,10)
R. Roettenbacher (6,7)
Schamm (4-5)
N. Van Rensen (9-10)
G. Willmann (2-3)

Project: (1) The 20 Mwe gas-cooled solar tower power plant
Ceramic panel tubing (GAST)
Construction with ceramics
Joining of SiSiC

(2) Non-destructive testing of SiSiC
Mechanical properties of SiSiC
Testing of one SiSiC panel under solar radiation at Almeria

(3) SiSiC heat exchanger for the steel and aluminium industry
Corrosion problems
Construction and design
Testing

(4) High-temperature (950°C) steam electrolysis for hydrogen production.
Development of electrical conducting and non conducting ceramics

(5) Electrodes for oxidizing and reducing atmosphere
Ceramic-Ceramic compounds
Ceramic-Metal compounds

(6) Development and utilization of cells with thin coatings for high-temperature electrolysis

(7) 20 Mwe gas-cooled solar tower power plant
Alternative ceramic receiver

(8) Oxygen sensor

(9) GAST Technological programme
Joining technology, ceramic-metal transistions, behaviour under temperature variations, oxidation behaviour

(10) High-temperature ceramic heat exchanger

(32) **Elektroschmelzwerk Kempten**
Postfach 1526
D-8960 Kempten

H. Knoch (1-5)

Project: (1) Influence of fabrication parameters on the mechanical and electrical properties of high-temperature ceramics

(2) Fabrication of absorbers for neutrons

(3) Utilization of ceramics in corrosive and erosive environments at high temperature

(4) Introduction of ceramics in thermal engines

(5) Improvement in the high-temperature properties of ceramics by hot isostatic pressing

---

(33) **Forsch. Inst. der Cremer Gruppe**
Postfach 1173
D-8633 Roedenthal

E. Gugel (1-2)
H.A. Lindner (1)
H.G. Nitzsche (1)

Project: (1) Characterisation of the mechanical behaviour of ceramics: Bending strength (20-1400°C), fracture mechanics; life time prediction

(2) Relationship between structural and mechanical properties

---

(34) **Fraunhofer Gesellschaft eV.**
Inst. für Silicatforschung
Neunerplatz 2
D-8700 Würzburg 2

Roggendorf (3)
Ruf (2)
H. Scholze (1-3)
Storch (1)

Project: (1) Crack formation measurement in ceramic materials by means of acoustic emission analysis

(2) Characterization of the resistance of ceramics to temperature variations by means of acoustic emission analysis

(3) Reactions between exhaust gases from glass melting tanks and fire bricks

---

(35) **Fraunhofer Institut für Werkstoffmechanik**
F.G. Nictmetallene Werkstoffe
Rosastrasse 9
D-7800 Freiburg

W. Doll (1-2)

Project: (1) Fatique behaviour of silicon carbide under solar conditions

(2) Evolution of the strength of ceramics under long-time loading and taking into account the residual stresses

---

(36) **Fraunhofer Institut für Zerstörungsfreie Prüfverfahren**
Uni. Geb. 37
D-6600 Saarbrücken 11

K. Goebbels (1-2)

Project: (1) Non destructive testing of high-temperature ceramic parts of automotive gas turbines

(2) Localization, classification and reconstruction of defects by non destructive testing processes for the evaluation following the fracture mechanics rules

---

(37) **Hobeg mbH**
Zentralabteilung Projekte ZAP
Postfach 110029
D-6450 Hanau

G. Luthardt (1)
D. Schoenfeld (1)

Project: (1) Development and characterization of coatings for preventing and permeation

---

(38) **Hochschule der Bundeswehr München**
Fachbereich Luft-Raumfahrt
Werner-Heisenbergweg 39
D-8014 Neubiberg

K. Heckel (1)

Project: (1) Resistance and life time of ceramics under static and dynamic stresses

---

(39) **Hutschenreuther AG**
Centrallabor
Postfach 1340
D-8672 Selb

C. Hahn (1-2)
W. Schmidt (1)

Project: (1) Influence of raw material and processing parameters on the strength of ceramics and ceramic composites (made by infiltration or/and by sintering)

(2) Influence of preparation parameters on some properties of ceramic material and ceramic components

---

(40) **K.F.A.-Julich**
Inst. für Reaktorwerkstoffe
Postfach 1913
D-5170 Jülich

F.E. Buresch (1-6)
Gyarmati (1)
Luhleich (1)
Naoumidis (2)

Project: (1) Development of preparation processes for special structural properties

(2) Development of joining methods

(3) Influence of treatments under high-temperature HTR operating conditions on the mechanical and physical properties of ceramics

(4) Influence of preparation parameters on the strength of ceramics

(5) Influence of the structure on the damage evolution in ceramics

(6) Damage evolution theory in ceramics

---

(41) **Kloeckner-Humboldt-Deutz AG**
Ottostrasse 1
D-5000 Köln-Porz

N. Zernig (1)

Project: (1) Thermal insulation of cylinder-heads of air-cooled engines by portliner and combustion-head plates

---

(42) **Kraftanlagen Aktiengesell.**
Im Breitspiel 7
D-6900 Heidelberg

Fetzer (1-2)
E.W. Gellersen (1-2)

Project: (1) Ceramics: material research and applications
(2) Development and fabrication of high-temperature ceramic heat exchangers

---

(43) **Kuehnle, Kopp & Kausch AG**
Heszheimer Strasse 2
D-6710 Frankenthal

H. Cropp (1)

Project: (1) Ceramic components for exhaust gas turbochargers

---

(44) **Max Planck Institut für Metallforschung. Inst. für Werkstoffwissenschaft**
Seestrasse 92
D-7000 Stuttgart 1

V. Gerold (1-7)
R.F. Pabst (8)

Project: (1) Micromechanisme of crack extension at room and high-temperature

(2) Direct observation, crack formation, kinetics (JR. Curves) J. Integral

(3) Strength, bioceramics, life-time

(4) Dynamic and cyclic-dynamic fatique, G function, n(t), KIC(t) at room and high temperature

(5) Sub-critical crack growth in partially stabilized MgO doped ZrO_2 at high temperature

(6) KR-curves as a function of structure and temperature

(7) KIC as a function of 0, temperature, structure

(8) Statistics and sub-critical crack growth at room and high temperature

---

(45) **Max Planck Institut für Metallforschung**
Pulvermetallurgisches Lab.
Heisenbergstrasse 5
D-7000 Stuttgart 80

N. Claussen (1,5,6)
P. Greil (2,3)
G. Petzow (1,4)

Project: (1) Optimisation of non-oxide, non-metallic materials

(2) Determination of the thermodynamical and mechanical properties and characterization of the structure of Si_3N_4 containing ceramics

(3) Strengthening of ceramics by phase transformation

(4) Low thermal expansion ceramics

(5) Fabrication of fine grain size and amorphous ceramic powder

(6) Hot isostatic pressing of ceramics

---

(46) **Max Planck Institut für Plasmaphysik**
AG Plasma-Wand-Wechselwirkg.
D-8046 Garching

R. Behrisch (1-2)
B. Scherzer (1-2)

Project: (1) Erosion of carbides by hydrogen atoms at temperatures between 300 and 1500 K

(2) Erosion of high-temperature materials by bombardement with hydrogen and helium ions of 50 eV up to 150 KeV

---

(47) **Motoren und Turbinen Union**
GWA1
Dachauerstrasse 665
D-8000 München 50

K. Hagemeister (1)
Huether (1)
W. Krueger (1)

Project: (1) Development of high-temperature ceramic parts for gas turbines

---

(48) **Ringsdorff-Werke GmbH**
Postfach 210187
Drachenburgstr. 1
D-5300 Bonn 2

H. Persicke (1)
W. Ulsamer (1)

Project: (1) Development of special fine grain graphite
HT reactor core, structural elements, diamand synthesis, semi conductor technology, hot pressing, continuous casting of non ferrous metals, trace analysis

---

(49) **Karl Schmidt GmbH**
Postfach 1351
D-7107 Neckarsulm

Hielke (1)
W. Sander (1)

Project: (1) Utilization of ceramics for improving the thermal loading capacity and as thermal barrier on pistons of internal combustion engines

---

(50) **Sigri Elektrographit GmbH**
Forschung/Technikum
Postfach 1160
D-8901 Meitingen

H. Boder (1)
Duebgen (1)
H. Gruber (1)
W. Heider (1)

Project: (1) Development of ceramic components for applications at high temperatures

---

(51) **Hermann C. Starck Berlin werk Goslar**
Postfach 2540
D-3380 Goslar 1

B. Krismer (1-2)
G. Schwier (1-2)

Project: (1) Development and manufacture of improved silicon carbide powder for sintering and hot pressing

(2) Development and manufacture of improved silicon nitride powder for sintering and hot pressing

---

(52) **Technische Universität Berlin**
Inst. Nichtmetall. Werkstoffe
Englischestrasse 20
Berlin

H. Hausner (1-5)

Project: (1) Ceramic powder synth., decomp. of organometallic comp., precipitation from solutions. Influence of the process on the powder charact.; their sintering behaviour

(2) Mechanical properties of ceramics. Influence of the structure on the bending strength, fracture toughness and creep behaviour

(3) Evolution of the structure during the sintering of ceramics under various conditions. Quantitative characterization of the structure

---

(4) High-temperature behaviour of oxide and non-oxide ceramics. Influence of sintering aids

(5) Electrical properties of ceramics

---

(53) **T.U. Clausthal**
Inst. für Steine und Erden
Zehnterstrasse 2A
D-3392 Clausthal-Zellerfeld

G.H. Frischat (1-3)

Project: (1) Nitrogen glasses

(2) Metallic glasses, gas solubility

(3) Chalcogene glasses

---

(54) **Universität Erlangen-Nürnberg**
Werkstoffwissenschaften I
Martenstrasse 5
D-8520 Erlangen

Buegler (2-4)
Devezas (1)
B. Ilschner (1-2)
Kleinlein (1)
Kritz (1)

Project: (1) Stress and temperature dependence of the slow crack growth of Al_2O_3 and Si_3N_4

(2) Influence of temperature variations on the long time strength of ceramics

(3) Influence of a cyclic thermal stress on the slow crack growth of ceramics containing various amount of grain boundary phase

(4) Static fatique and fracture behaviour of silicon nitride between room temperature and 1400°C

---

(55) **Universität Erlangen-Nürnberg**
Werkstoffwissenschaften III
Martenstrasse 5
D-8520 Erlangen

H. Moertel (1-2)
G. Tomandl (1-2)

Project: (1) Sintering with additives

(2) Behaviour of grid bricks in the middle portion of regenerative chambers of glass melting furnaces

---

(56) **Universität Hamburg**
Inst. f. Phys. Chemie
Laufgraben 24
D-2000 Hamburg 13

W. Gunszer (1-4)

Project: (1) Crystalline and amorphous oxide with a garnet structure

(2) Phase transformations in mixed oxides

(3) Influence of the prepartion conditions on the physical properties of oxides

(4) Influence of radiations on amorphous oxide

---

(57) **Universität Karlsruhe**
Kaiserstrasse 12
D-7500 Karlsruhe

D. Munz (1)
Rosenfelder (1-2)

Project: (1) Life time prediction of ceramic components

(2) Influence of fabrication defects on the strength of ceramics

---

(58) **Universität Karlsruhe**
Inst. Chemische Technik
Kaiserstrasse 12
D-7500 Karlsruhe

E. Fitzer (1-2)

Project: (1) Strength and fracture behaviour of $MoSi_2$ reinforced by refractory metals

(2) Carbon fibres reinforced SiC and Si_3N_4 by phase impregnation

---

(59) **V.A.W. AG**
Leichtmetallforschungsinstitut
Postfach 2468
D-5300 Bonn 1

R. Feige (1)

Project: (1) Development of synthetic raw materials for the fabrication of ceramics and refractories

---

(60) **Volkswagenwerk AG**
Forschung-Antriebstechnik
Postfach
D-3180 Wolfsburg

P. Rottenkolber (1)

Project: (1) Development of ceramic turbine components for car gas turbines

---

(61) **Nat. Inst. for Higher Educat.**
Plassy techn. Park
Limerick

J. Bolton (4)
S. Hampshire (1-4)

Project: (1) Fabrication and properties of alpha-sialon

(2) Oxidation of Si_3N_4 - based ceramics

(3) Preparation and characterization of Sialon glass-ceramics

(4) Fracture mechanics of high temperature materials

---

(62) **University College Dublin**
Upper Merrion Street
Dublin 2

M. Farmer (1)
S. Timoney (1)

Project: (1) Ceramic materials for diesel engine pistons and liners

(2) Friction properties of ceramic materials

---

(63) **C.N.R.**
Ist di Ricerche Technologiche
per la Ceramica
Via Granarolo 6
I-48018 Faenza Ra

G.N. Babini (1)
A. Piegna (4)
G.L. Ortali (3)
P. Vincenzini (1-4)

Project: (1) Resistance to oxidation and corrosion and mechanical properties at H.T. of Si_3N_4 produced by hot-pressing and sintering without application of external pressure

(2) Production and characterization of materials on lithium base for molten carbonate fuel cells

(3) Mullite coatings for photovoltaic cells

(4) Ionic conducting ceramics

---

(64) **Politechnico di Torino**
Ist. Chimica Gen. Appl. Metall.
Corso Duca Degli Abruzzi 24
I-10129 Torino

M. Montorsi (1)

Project: (1) Sintering of Si_3N_4

---

(65) **Stazione Speriment. del Vetro**
Via Briati 10
I-30121 Murano Venezia

G. Barbaglio (1)
G. Bonetti (1)
B. Locardi (1)

Project: (1) Development of glasceramic fibre

66

Universita di Trieste
Istituto di Chimica Applicata
e Industriale
Piazzale Europa 1
I-34127 Trieste

A. Cocco (5)
V. Longo (1-4, 7)
F. Ricciardiello (6)

Project: (1) Production of special ceramic materials by active oxygen

(2) Solar energy conversion by photovoltaic cells applying semiconducting ceramics

(3) Chemical, physical, structural and technological characterization of semiconducting ceramics and their possible use as alternative energy sources

(4) Relation between structure and mechanical properties of ceramic materials

(5) Study of refractory oxides

(6) Production and characterization of ZrO_2 base composites

(7) Ceramics and metalceramics

(67) **E.C.N. Energieonderzoek Centrum Nederland**
Postbus 1
NL-1755 ZG Petten

R. Blackstone (1)
J.H.N. Verheugen (1)

Project: (1) Materials research MHD-channel and heat exchangers

---

(68) **N.V. Kema - Div. of R+D**
Depts. SO/WBM-LMS
Postbus 9035
NL-6800 ET Arnhem

P.J.C. Bloem (1)
H.P.A.M. Van der Staak (1)

Project: (1) Investigation of refractories for coal gasification units

---

(69) **Philips Research Laboratories**
Prof. Holstlaan
NL-5600 JA Eindhoven

G. De With (1-2)

Project: (1) Mechanical properties of oxide and non-oxide ceramics at elevated temperature

(2) Hot pressing

---

(70) **Shell Int. Research Mij. BV**
RSRH/2
Postbus 162
NL-2501 AN Den Haag

J. Green (4)
P.R. Murray (1-3)
C. Stenger (5)
E.J. Van de Kraats (1-5)

Project: (1) Design parameters for pressurized components in ceramics, at 600°C

(2) Design parameters for valves in fly ash environment

(3) Resistance to slag attack

(4) Determination of the modules of rupture of magnesia and magnesia based refractory materials at high temperature (>1500°C) as a function of chemical and mineralogical composition

(5) Determination of the creep resistance of alumino silicates at high temperatures (>1400°C) as a function of chemical and mineralogical composition

---

(71) **S.K.F. engineering and research centre**
Postbus 50
NL-3430 AB Nieuwegein

R.T. Cundill (1)

Project: (1) Ceramic bearing components

---

(72) **T.H. Twente**
Dept. Inorg. Materials Science
Postbus 217
NL-7500 AE Enschede

A.J. Burggraaf (1-4)
T. Fransen (1)
P.J. Gellings (1-4)
J.R.H. Ross (4)

Project: (1) Ceramic membranes-Ceramic coatings

(2) Ceramic solid electrolytes and electrode materials

(3) Influence of processing and fabrication parameters on the microstructure and properties of fine grained ceramics (including strength)

(4) Preparation and characterization of ceramic based catalysts

---

(73) **TNO-Technisch physische dienst**
Bosrand 44
NL-5665 ER Geldrop

C.A.M. Siskens (1-2)

Project: (1) Development of high temperature materials (together with R. Metselaar T.R.U.E.)

(2) Development of coating materials (together with H.B. Zeedijk TNO-Met. Inst.)

---

(74) **Eindhoven University of Technology**
Postbus 513
NL-5600 MB Eindhoven

R. Metselaar (1-2)
L.R. Wolff (2)

Project: (1) Development of high temperature materials

(2) Cermet emitter for thermionic convertors

---

(75) **Eindhoven University of Technology**
Dept. of Electrical Engineering
Postbus 513
NL-5600 MB Eindhoven

W.J.M. Balemans (1)
L.H.TH. Rietjens (1)
M.C.M. Smeets (1)

Project: (1) Magnetohydrodynamic (MHD) Power Generation

---

(76) **Centr. Inst. for Ind. Research**
Dept. of H.T.M. and Corrosion
P.O. Box 350
N-Blindern, Oslo 3

P. Fartum (3)
I.A. Kvernes (1-4)
L. Nilsen (2)
B. Overlaender (4)

Project: (1) Thermal barrier coating on diesel engine parts

(2) Thermal barrier coating on gas turbine parts

(3) Advanced surface materials for tribological evaluation

(4) Development of ZrO_2 coating with improved creep/ thermoshock properties

(77) **Research Institute of Nationale Defense FOA**
P.O. 27322
S-10245 Stockholm

K.F. Alm (1-2)
C.O. Amundin (3)
B. Holmberg (1-3)

Project: (1) Phase-equilibria in ceramics

(2) Influence of fabrication methods on the properties of ceramics

(3) Pressure sintering

---

(78) **Studsvik Energitechnik AB**
Dept. Mat. Appl. Technology
S-61182 Nykoping

K. Engman (1)
T. Holm (1)

Project: (1) Ceramics for high temperature application

---

(79) **Swedish institute for silicate research**
P.O. Box 5403
S-40229 Gothenburg

R. Carlsson (1-3)
L. Hermansson (1-3)

Project: (1) High temperature ceramics for heat engines

(2) Refractory dry masses for coreless foundry furnaces

(3) Transformation-toughened ceramics

---

(80) **Chalmers University of Techn.**
Dept. of Engineering Metals
S-41296 Goteborg

R. Warren (1)

Project: (1) Fracture properties of hardmetals and ceramics from room temperature to 1000°C

---

(81) **Batelle Memorial Institute**
Research Centre Geneva
7, Route de Drize
CH-1227 Carouge

O. De Pous (1-4)
M. Kornmann (3)
D. Richon (1-2)

Project: (1) Pressureless sintering of Si_3N_4 for engineering application

(2) Low thermal expansion ceramics

(3) High temperature friction of ceramics

(4) Non oxide silicon ceramics '1990'

---

(82) **Brown, Boveri & Cie Ltd**
ABT. ZLC
CH-5401 Baden

A. Mayer (1)
M. Soucek (1)

Project: (1) Development of 'Comprex' ceramic roter for automotive Diesel engine

---

(83) **Ecole Polyt. Fed. de Lausanne**
Lab. de Ceramique
34 Chemin de Bellerive
CH-1007 Lausanne

P. Carry (1,4,6)
A. Mocellin (2,3,5)

Project: (1) High-temperature forming

(2) Preparation and properties of aluminosilicate base ceramics

(3) Synthesis and stability of aluminiumtitanate

(4) Microcracks induced by phase transformations in sintered V_2O_3

(5) Quantitative metallography of polycrystals

(6) Plastic deformation of polycrystalline oxides

(7) Extension to other systems of some above mentioned project

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(84) **Ver. Drahtwerke Biel**
Entwicklungsabteilung
Neumarktstrasse 33
CH-2500 Biel

P. Brunner (1-3)

Project: (1) SiC deposition from the gas phase

(2) Al_2O_3 deposition from the gas phase

(3) HIP'ing of ceramics

---

(85) **Admiralty Marine Technology Establishment**
Metallurgy and Ceramics Div.
Holton Heath
BH16 6JU Poole

J.F. Conde (1)
D.J. Godfrey (1)

Project: (1) Creep and stress rupture of ceramics; high temperature strength measurements

---

(86) **Anderman and Ryder LTD**
Central Avenue
KT8 OQZ East Molesey

D.R. Cooper (2-3)
R.C. Hawkins (1)
M.W. Real (1)

Project: (1) Zirconia development

(2) Strength in different environments

(3) Corrosion resistance

(4) Impact/wear resistance

---

(87) **BA Chemicals LTD**
Burntisland
FIFE

A. Agnaw (1)
K.A. Evans (2)

Project: (1) Development of improved alumina powders for ceramic fabrication

(2) Production of alumina sols

---

(88) **BP Research Centre**
New Technology Division GRD
Chertsey Road
TW16 7LN Sunbury on Thames

S.E. Bold (1-2)

Project: (1) Refractory erosion in fluid catalytic cracking units in oil refineries

(2) Fracture toughness of ceramics

---

(89) **British Ceramics Research Ass.**
Refract. and Ind. Cer. Div.
Queens Road
Penkhull
ST4 7LQ Stoke on Trent

W.R. Davis (12)
J.B. Everill (14)
P.T.A. Hodson (3,5,9)
M. Lester (6,7,11)
D.E. Lloyd (10-15)
G.C. Padgett (1-10)
F.T. Palin (1-2)

Project: (1) Engineering of refractory-lined structures to minimise degradation due to thermo-mechanical stress

(2) The use of acoustic emission to asses degradation of refractory linings due to thermo-mechanical stress

(3) Fracture mechanics and microstructure of refractories

(4) High temperature strength vs composition and texture

(5) Mechanical & thermal properties of semi-insulating refractories

(6) Test methods for the assessment of monolithic refractories

(7) Development of thermal shock test method

(8) High temperature kiln furniture

(9) Effect of oxidation on silicon carbide performance

(10) Improvement of strength of materials for HT batteries

(11) Effect of heat on devitrification of ceramic fibres

(12) Non-destructive testing of refractories

(13) Fabrication of complex shapes

(14) Specifications for refractories

(15) High temperature properties of C.V.D.-deposided mirrors

---

(90) **British Gas Corp. London Res. ST.**
Phys. Meth. and Mat. Group
Michael Road
SW6 2AD London

F. Starr (1-2)

Project: (1) Gas attack on refractories

(2) Slag attack on refractories

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(91) **British Gas Corporation**
Midlands Research Station
Wharf Lane
BG1 2JW Solihull

P. Knowless (1)

Project: (1) Monitoring of the mechanical performance of gasification plant components

---

(92) **British Steel Corp.**
Special Steels Div.
Stockbridge and Tinsley Park
S30 5JA Stockbridge

K. Hills (1)

Project: (1) Slag-based ceramics (together with P.C. Rogers Imperial College of Sc. and Tech.)

---

(93) **Centr. Electr. Generating Board**
South Western Region
Bedminster Down
Bridgewater Road
BS13 8AN Bristol

B.J.R. Hodgson (2)
M.B.J. Low (1-3)
D. Warner (1,3)

Project: (1) Effects of vibration on high temperature fibrous insulation

(2) Fibre reinforced refractories

(3) Structural applications of carbon/carbon composites in fast neutron irradiation environments

---

(94) **Chloride Silent Power LTD**
Davy Road, Astmoor
Runcorn

S.R. Tan (1)

Project: (1) Development of beta-alumina for electrochemical devices

---

(95) **Eng. Clays, Lovering Pochin & Co**
John Keay House
St. Austell

C.S. Hogg (1)
B.B. Waldron (1)

Project: (1) The use of calcined kaolins in refractory applications

---

(96) **GEC Power Eng. Ltd.**
Stafford Laboratory
P.O. 30
Lichfield Road
ST17 4LN Stafford

R. Banks (1-3)
C.A. Elyard (1-3)
G. Partridge (3)

Project: (1) Nucleation and crystallisation studies of glass-ceramics

(2) Fundamental study of adhesion of glassceramics to refractory metals

(3) Glass-ceramics coatings for refractory metals

---

(97) **Hepworth Iron Co.**
Stocksbridge
S30 5H6 Sheffield

Crowter (1)
Shaw (1)
J.M. Woodfine (1)

Project: (1) Strength (at room temperature) of heavy clay based ceramic materials

---

(98) **ICI Mond Div., Research Dept.**
P.O. Box 12
The Heath
Runcorn

K. Kendall (1)

Project: (1) Structure and properties of high temperature materials

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99

Morgan Thermic Ltd.
Bewdley road
DY 13 8QR Stourport-severn

P. Bosomworth (3)
J. Briggs (1-6)
C. Hampson (1)
P. Horning (5)
R. Julietti (4)
J. Kirk (6)
D. Williams (4)

Project: (1) Development of improved high temperature insulating materials

(2) Improvements in erosion and corrosion testing of refractories

(3) Thermal shock of refractories and engineering ceramics

(4) Chemical analysis of nitride and oxynitride phases in refractories

(5) Ceramics for engine components

(6) Fabrication and testing of transformation toughened ceramics

(100) **National Physical Laboratory**
Div. of Materials Applications
Sect. Mech. Prop. of HT-Material
TW11 OLW Teddington

E.A. Almond (3-4)
T.I. Barry (5)
E.O. Hondros (1-5)
R. Morrell (1-2)

Project: (1) Compilation of handbooks on the properties of commercially available ceramics including supportive materials characterization

(2) Design and construction of a large-area thermal conductance test facility for furnace insulations, leading to industrial collaborative measurement programme

(3) Improvements in mechanical tests of tool materials

(4) Diffusion bonding

(5) Metallurgical and thermochemical data (in conjunction with Harwell)

---

(101) **North Staffordshire Polytech.**
College Road
ST4 2DE Stoke-On-Trent

D.F. Dailly (1)
G.J. Gittenis (1)

Project: (1) Properties of alumina in relation to fabrication and microstructure

---

(102) **Polytechnic of Wales**
Treforest
Pontypridd
Mid Glamorgan

S. Wild (1)

Project: (1) The function of Mg containing betasialons

---

(103) **Imperial College of Sc. & Tech.**
Depart. of Metall. & Mater. Sc.
Prince Consort Road
SW7 2BP London

E.P. Butler (2,10)
J. Kilner (3)
J. Owen (4)
P. Pratt (8)
R. Rawlines (6)
P.S. Rocers (7)
B.C.H. Steele (1,5-11)

Project: (1) Development of zirconia based electrolytes

(2) Microstructure/property: Tough ceramics

(3) Oxygen ion conduction in ceramics and associated influence of microstructure

(4) Lithium and sodium conduction in crystal line oxides and sulphides

(5) Lithium and sodium conduction in novel glasses

(6) Mechanical properties of ceramic prosthetics

(7) Fabrication of glass-ceramic components from slags and fly ash

(8) Mechanical properties of cement paste

(9) Oxygen exchange with oxides

(10) Sintering characteristics of novel oxide powders

(11) Surface characterization of ceramic oxides

(104) **Sandvik Ltd.**
Hard Materials Research Centre
Torrinton Avenue
CV4 9AD Coventry

D.H. Jack (1)
V. Thompson (1)

Project: (1) HT strength of cemented carbides and other cutting tool materials

---

(105) **Harwell UKAEA**
AERE, Building 552
OX11 ORA Harwell Didcot

J. Cairns (5)
R.W. Davidge (3,4)
D.T. Livey (2,3,7)
P. McGeehin (1,6)

Project: (1) Composite materials and engineering

(2) Surface treatment and coatings

(3) Ceramic engineering

(4) Thermal insulation

(5) Gel processing

(6) Electrical ceramics

(7) Pulverised fuel ash products

---

(106) **UKAEA-AERE**
Materials Development Div.
Harwell
OX11 ORA Didcot

M.J. Bennet (1)
M.R. Houlton (1)
J.B. Price (2)

Project: (1) Ceramic coating produced by sol-gel technology and vapour deposition procedures for improved surface protection

(2) The effect of simultaneous mechanical and thermal stress upon the corrosion protection afforded by ceramic coatings produced by sol-gel technology and vapour deposition procedures

---

(107) **University College of Swansea**
Metall.-Mat. Techn. Dept.
Singleton Park
SA2 8PP Swansea

D. Homer (2-4)
B. Wilshire (1)

Project: (1) High temperature creep and fracture of refractories

(2) Pitch bearing magnesia refractories

(3) The influence of technological and economic trends in the steel industries on the pattern of demand for refractories

(4) The influence of technological and economic trends in the bulk non-ferrous industries on the patterns of demand for refractories

---

(108) **University of Aston**
Metallurgy-Mat. Eng. Dept.
B15 2TT Birmingham

M.H. Loretto (1-2)
R.E. Smallman (1-2)

Project: (1) Transmission and scanning transmission electron microscopy study of WC-Co composites

(2) Brazability of WC-Co tool materials

---

(109) **University of Bath**
School of Materials Science
Claverton Down
BA2 7AY Bath

R.G. Cooke (1-2)
B. McEnaney (3)

Project: (1) Fracture of graphites

(2) Fracture of polyphase, coarse-textured ceramics

(3) Diffusion of gases in nuclear graphites

---

(110) **University of Cambridge**
Engineering Department
Trumpingtonstreet
CB2 1PZ Cambridge

M.F. Ashby (10)

Project: (1) Hot-isostatic pressing, particularly of tool steels, super alloys and engineering ceramics

---

(111) **University of Cambridge**
Metallurgy and Mat. Science
Pembrokestreet
CB2 3QZ Cambridge

T.F. Page (1-4)

Project: (1) HT mechanical properties of porous ceramics

(2) Micro-hardness, friction and wear of SiC and Si_3N_4 materials as a function of load, temperature and environment

(3) HREM investigation of the nature and role of grain boundaries and interfaces in high-performance materials

(4) HT mechanical properties of highly porous ceramics

---

(112) **University of Durham**
South Road
Durham City

P.M. Braider (1-3)

Project: (1) Evaluation of ceramics in metal cutting operations

(2) Evaluation of ceramics in rock cutting

(3) Failure criteria for ceramic components

---

(113) **University of Exeter**
Dept. of Chem. Engineering
Northcote House
The Queens Drive
Exeter

T.W. Davies (1)

Project: (1) Flash calcination of kaolinite

---

(114) **University of Leeds**
Dept. of Ceramics
LS2 9JT Leeds

R.J. Brook (7-16)
P. Knott (21)
A.J. Moulson (14,15)
F.L. Riley (1-4)
E.W. Roberts (22,23)
R. Stevens (5,8)
D. White (6,24)
W.E. Worrall (17-20)

Project: (1) Sintering of reaction bonded silicon nitride

(2) Fabrication of sintered silicon carbide

(3) Oxidation of beta-sialons

(4) Nitridation of silicon in high purity conditions

(5) Toughening of beta-Al_2O_3

(6) Toughening of refractories

(7) Reactive sintering of ZrO_2/Mg_2SiO_4 ceramics

(8) Partially stabilized ZrO_2

(9) Fast firing of $BaTiO_3$

(10) Hot pressing of high purity MgO

(11) Sintering and coarsining of Al_2O_3 powder

(12) Selection of sintering additives for ZrO_2

(13) Control of surface diffusion

(14) Optical scattering in PLZT

(15) Electrical porcelains

(16) Ionic conduction of Bi_2O_3 films

(17) Rheological properties and particle size

(18) Separation of clay minerals

(19) Applications of cluster analysis to clay

(20) Rheology of mono-ionic montmorillonites

(21) Colour generation in glass ceramics

(22) Fabrication of endosseous implants

(23) Wear of ceramic on ceramic devices

(24) Chipping of vitreous enamels

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(115)

University of Manchester
Simon Engineering Laboratories
Oxford Road
M13 9PL Manchester

P. Stanley (1-3)

Project: (1) Assessment of mechanical properties

(2) Response to and analysis of thermal stresses

(3) Development and application of probabilistic design techniques

---

(116) **University of Newcastle u. Tyne**
Dept. of Metallurgy & Eng. Materials
Haymarket Lane
NR1 7RY Newcastle upon Tyne

P. England (3)
A. Hendry (4,7,8)
K.H. Jack (1-7)
P. Korgul (4)
D.P. Tompson (1,3-6)
M.B. Trigg (2)

Project: (1) The processing and fabrication of dense, pressureless sintered beta-sialons

(2) Alpha-sialons: preparation, characterization and densification

(3) SiC-ALN Ceramic alloys

(4) Contributions of electron microscopy to the characterization of nitrogen ceramics

(5) The structural characterization of sialon polytypiods

(6) Nitrogen glasses

(7) The production of silicon nitride and sialons from natural raw materials

(8) The production and characterization of new hard metals for cutting tools and abrasives

(117) **University of Sheffield**
Dept. of Chem. Engineering
Newcastlestreet
S1 3JD Sheffield

N.H. Brett (5-6)
M. Cable (2-4)
J.C. Carling (15)
J.O. Isard (1)
P.F. James (14)
P.F. Messer (12,13)
S. Parke (8)
B. Rand (7,11)
H. Rawson (1)
J.H. Sharp (9,10)

Project: (1) High temperature spectroscopy of glass melts

(2) Post medieval glass melting techniques

(3) Refining of lead crystal glasses

(4) Properties of high lime, low alkali silicate glasses

(5) Neutron and XRD of zirconia gels

(6) Mixed spinel phases

(7) Fire clay casting slips

(8) Colours in ceramic glaze stains

(9) The microstructure of refractory high-alumina cements

(10) The synthesis of strontium hexaferrite

(11) Alumina-graphite refractories

(12) Vitrified whitewares

(13) Electrical porcelain from spray-dried granules

(14) Glass fibres by the sol-gel method

(15) Mathematical modelling of glass furnaces

(118) **Zirconal Ltd.**
Little Reyd Mill, Low Road
Earlsheaton
Dewsbury

J.M. McCullough (1-5)

Project: (1) Thermal fatique of refractories

(2) Development of new techniques of fabrication

(3) Application of re-iterative programming techniques in Weibull strength analysis

(4) Mathematical modelling of sub-critical crack growth in refractory structures subject to complex thermal and mechanical stresses

(5) Application of dynamic fatique data to the prediction of failure in refractory components subject to stress relaxation processes

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European Communities – Commission

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