

Conference Report

**'THE GLOBAL BUSINESS OUTLOOK FOR ADVANCED
CERAMICS AND CERAMIC MATRIX COMPOSITES'
CLEARWATER BEACH, FLORIDA, USA
(11–13 MARCH, 1987)**

The conference was organized by Gorham International Inc. who stated that its aims were

- (i) to establish valuable contacts between leaders from the ceramic industry, business, the universities and research institutes, and government agencies;
- (ii) to obtain first-hand knowledge of the latest developments;
- (iii) to gain insight into which market segments would grow the fastest and be most profitable;
- (iv) to hear first-hand about the global status of new products and processes; and
- (v) to participate in spirited open-forum discussions on topics of interest.

Gorham International is a contract research and development organization established in 1956. Their expertise lies in technical and business development of materials in general. At the present time they operate a number of multiclient projects in the field of advanced ceramics. Thus, the information which was obtained at this conference was of as much use to their own organization as to the representative of companies and other bodies who attended. There were about 125 participants, of which 90 were from the USA, the rest from elsewhere but surprisingly only one from Japan. It was therefore a relatively small meeting for this particular field where

conferences are usually attended by a large number of people. This was a rather pleasant change as one could easily find anybody one wanted to speak to. In this, one was assisted by lapel labels which were written in large letters, easily readable from a distance. (Future meeting-organizers please note that lapel labels with the names in ordinary typescript are useless!) The venue was an excellent choice, everybody appreciated the sunshine after a hard winter even if the rather full programme did not leave much spare time during the day. There were 12 papers and 3 panel discussions. Each panellist made a short prepared statement which was followed by an open discussion. The general chairman was Dr R. N. Katz who greatly contributed to the relaxed atmosphere.

The emphasis at the conference was on applications of ceramics in heat engines, cutting tools and other wear parts, for which the rather imprecise description of 'structural ceramics' was often used. There was much less coverage of electro/optical ceramics; bio-ceramics, an important future market according to the forecasts, were hardly mentioned at all.

The whole field of advanced ceramics was surveyed by Roy Rice in an after-dinner lecture, entitled 'Opportunities and challenges', with many examples from his work at the Naval Research Laboratories. Amongst the key issues facing future development which he mentioned were: reproducibility of properties, reliability of components, cost and the need for non-catastrophic failure or, as it was frequently referred to by following speakers, 'graceful fracture'. Hopes were expressed that this could eventually be achieved by using continuous fibre-composites or whisker-reinforced ceramics. The latter are generally produced by hot-pressing but in a paper by Terry Tiegies of the Oak Ridge National Laboratory it was shown that up to 20 vol% of silicon carbide whiskers could be incorporated in alumina using pressureless sintering.

Silicon carbide whisker-reinforced alumina was singled out as the most rapidly commercialised recent development, particularly as a cutting tool. An interesting observation was made by J. V. Milewski who pointed out that, in spite of the present high cost of whiskers (\$200–300 per kg), an alumina cutting tool containing 1–2 dollars worth of silicon carbide whiskers sells at \$35, whereas the whiskerless cutting insert sells at only \$8. Obviously, the improved performance justifies to the the user the increased cost. A recent market forecast for whisker-reinforced ceramic composites envisages an increase of sales from \$10–12m in 1986 to \$385–410m in 1996.

The cost of raw materials has already been mentioned. It appears that this is a 'chicken or egg' situation. The cost of the starting powders will decrease with increasing demand (e.g. alumina used for sparking plugs) but the demand will increase only if components can be produced at a reasonable cost. This vicious circle will probably be broken by the Japanese

through their commitment to a long-term target. They ask themselves: 'will this increase the activity of the company' and not 'how much profit will this make?' Nippon Steel asked themselves the first question in 1982 when they decided on a large diversification project to counter the falling demand for steel. Their achievements in the development of advanced ceramics during the last 5 years are truly impressive.

The chairman ventured to appraise the worldwide market situation for advanced ceramics; for 1985, excluding military applications, he quoted \$5-500m with a split between electronic and structural products of 80:20. Very substantial increases were foreseen for the next 20 years due to present developments of applications in heat engines and the medical field, and he predicted that during the period 1995-2000 structural ceramics would overtake electronic ceramics. Nobody ventured to make any predictions about the recently discovered 'high-temperature' superconducting ceramics. The figures quoted by the chairman were at some variance with those of an earlier (1984) forecast by Gorham which now appears to have been over-optimistic. One wonders what the figures will be in 3 years from now. The assessment of the future market depends not only on potential applications but also on a judgement of when the technical problems can be solved.

Crucial in forecasting are the developments of applications in the automotive industry which were dealt with in considerable detail by R. R. Wills (TRW). Amongst various arguments he showed that much greater fuel savings can be achieved by a more aerodynamic design of the body of a heavy truck than by the introduction of a heat-insulated, turbo-charged and turbo-compounded engine using ceramics. One asks why this is not done. The answer is probably that too much money is invested in expensive body-manufacturing plant to replace it by another costly new plant. The same argument can also be applied to engine manufacture. Thus, there is not only the time factor involved in solving the technical problems but also the consideration of plant investment. Besides these points institutional issues, e.g. the supply of skills, were also discussed.

Over all, this was a very informative and enjoyable conference. The organizers must be congratulated for the very professional handling of the event. All speakers must have been instructed to provide hand-outs which contained all the slides shown. This meant that one could follow the talks with a certain degree of leisure without the continuous clicking of cameras often met with at other conferences, and attendees had a considerable amount of information to take home with them.

I would be pleased to provide a more detailed report of this conference for anybody who is interested.

Paul Popper