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**Research area: Product aims**

Paper, paperboard and board // Technical specialty papers

**Key words:**

Rapid prototyping, laminated object manufacturing-, ceramic paper, aluminium oxide, silicon carbide

**Title:****Rapid Prototyping of cellulose derived SiC-Composit-ceramics with LOM-technique****Background/Problem**

The international competition results in the necessity to develop new products more rapidly and less cost intensively. With increasing number of more and more complex products and simultaneously rising demands concerning products quality optimisation of the developing process is necessary. In particular the costly manufacture of prototypes represents a weak point of the developing process and consumes up to 25 percent of the production time. With rapid prototype techniques like stereolithography (SLA), selective laser sintering (SLS), fused deposition modelling (FDM) or laminated Object manufacturing (LOM) it is possible to realize complex prototypes with high accuracy and with much less effort.

The manufacture of prototypes and small series of ceramic products for example by slip casting is very cost intensive. An interesting alternative to realize ceramic prototypes represents the LOM-technique using pre-ceramic papers as raw material.

**Research objective/Research results**

The use of pre-ceramic paper highly filled with ceramic powders for the LOM technique represents a new route to realize ceramic prototypes. For this purpose the PTS is developing special, highly filled papers varying the filler type, filler content and composition as well as particle size. Starting in laboratory scale successful paper types will be transferred to the pilot facility of the PTS to manufacture pre-ceramic papers in a continuous production process. The project partner of the joint project (Friedrich-Alexander-University of Erlangen, Chair III for Glass and Ceramics) is developing cutting and gluing techniques to adjust the pre-ceramic papers to the LOM procedure and is converting the resulting paper structures in ceramics by high temperature treatment.

Until now different pre-ceramic papers with aluminium, silicon, aluminium oxide and silicon carbide powders as fillers with particle sizes in the range of 0.8 and 30 µm were realized. Filler contents up to 90 mass-% with retention in the range of 85 and 95 mass-% were achieved. The pre-ceramic papers showed sheet weights in the range of 200 and 300 g/m<sup>2</sup>. To improve the surface quality a special ceramic coating was developed. The cutting process was performed using a CO<sub>2</sub>-Laser system or steel knives, the gluing of the paper sheets was carried out using thermoplastic adhesives. Starting on laboratory scale optimized aluminium oxide papers were transferred to pilot scale on the pilot plant of the PTS in Heidenau. In this context about 200 meters of pre ceramic paper was produced in a continuous process. Based on this paper and the developed adaptations to the LOM process first ceramic structures like gear or turbine wheels could be realized.

**Application/Economic benefits**

The effort to manufacture ceramic prototypes and small series of ceramic products can be strongly reduced by rapid prototype techniques. In this context the LOM technique based on pre-ceramic papers represents a very effective and economical route for the ceramic industry. The realization of pre-ceramic papers in the paper industry appears to be possible in principle, since existing process engineering techniques need only to be modified in a suitable way to manufacture such paper. Although the production volume appears relatively small for the paper industry sector, pre-ceramic papers represent an interesting and profitable new product for small and flexible paper companies.

**Project period: 01.11.2004 – 31.12.2006**

**Remarks**

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