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DKG 2/2023

Berichte der Deutschen Keramischen Gesellschaft

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100th VOLUME

REPORTS – DKG Annual Meeting 2022, SVMT Expert Group, fem | **PROCESS ENGINEERING** – Calcium Zirconate Refractories for Improved Titanium Investment Casting, Powder Press Shaping of Magnetic Materials, Digital Printing Technology for Ceramic Surfaces, Ceramic Nanoparticles Synthesis by Laser Vaporization, Fabrication of Self-Biased Circulators Using LTCC Technology, Inorganic Filtration Membranes

Switzerland

4th Meeting SVMT Expert Group

In December 2022, the 4th Annual SVMT Expert Group Powder Technology meeting was again a hybrid event organised by the experts Dr Frank Clemens, Empa Dübendorf/CH; Prof. Alberto Ortona, SUPSI/CH; and Prof. Efrain Carreño-Morelli, HES-SO, Sion/CH. Due to positive feedback in 2021, the meeting was again organised in hybrid form. Thanks to Prof. Alberto Ortona, the meeting was organised by HM Lab. – MEMTi – SUPSI at USI-SUPSI East Campus in Lugano-Viganello under the motto Processing of Nitride- and Carbide-Based Ceramics and Hardmetals. More than 25 participants from industry and research labs with a focus on Powder Metallurgy, ceramics and inorganic fillers were present at the hybrid meeting. After the opening by Prof. Alberto Ortona, the meeting started with a short presentation of the SVMT (Swiss Association for Materials and Technology) by Dr F. Clemens. Afterward, 7 lectures from academia and industry on nitrides and carbides were followed by enriching discussions with the participants.

G. Balestra (SIP S.A./CH) presented **Compounding of High-Loaded Thermoplastic Polymers for Fused Filament Fabrication**. In his talk, he described the compounding of polymers with high mineral and iron filler content. He showed, that during compounding in a double screw extruder one of the main challenges is the abrasion of metal parts in the machines. This results in high production costs for the composite materials.

R. Gilardi (Imerys Graphite & Carbon/CH) gave an inside on **The Role of Carbon in Powder Metallurgy and Hardmetals.** In the beginning, he showed the production of different carbon forms (natural and synthetic graphite as well as carbon black) and discussed their various atomic structures. Later, the use of the three different carbon forms in powder metallurgy and hardmetals were shown. Although graphite powder is only a minor component of the formulation it plays a key role in the final properties.

Before lunchtime, G. Bianchi and M. Pelanconi (both SUPSI/CH) gave a presentation on **Design and Additive Manufacturing of Complex Ceramic Architecture by Binder Jetting on Carbide-Based Powders**. Based on a finished Innosuisse project, together with the Institute for Solar Energy and the Applied University OST, they described how to come from a basic to the final design by using computational design tools. Using the computational design tool, the development of a heat and mass exchanger by using thermochemical storage with aqueous sodium hydroxid was demonstrated, successfully.

The afternoon session started with a talk by E. Faude (WMC Sinterstar AG/CH) on **State-of-the-Art and Future Perspec-**

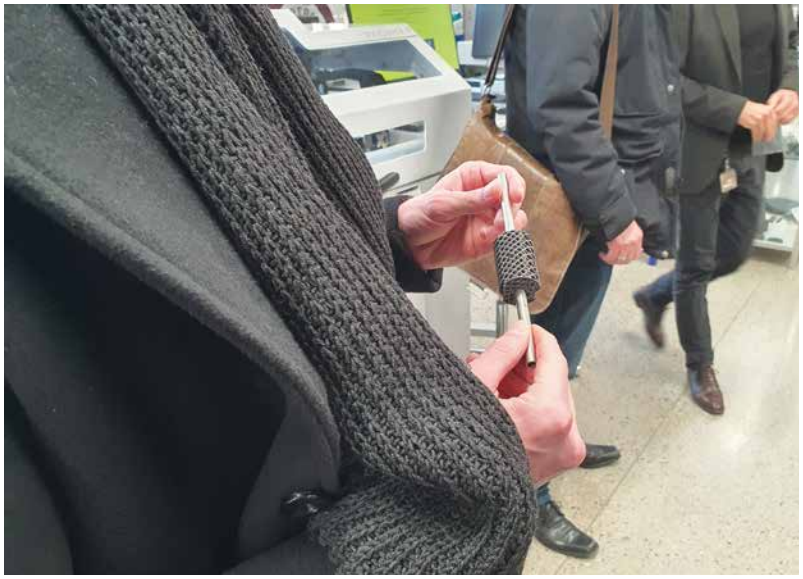

Fig. 1 Demonstration of the graphite based heat and mass heat exchanger

Fig. 2 Participants in front of the binder jetting machine

tives of Cemented-Carbide Production. He started with an overview of different application fields. More than 60 % of the hardmetal parts are used in mechanical engineering and production. Later he showed the effect of the tungsten carbide grain size and the cobalt content on the hardness, flexural strength, fracture toughness and thermal conductivity. Later the effect of different metal binder compositions was investigated. The highest toughness could be achieved using a FeNi binder system whereas, with a CoCr composition, the hardness could be maximised.

Prof. E. Carreño-Morelli (HESSO Vallais Wallis/CH) presented his newest results on the **Development of Hardmetal Cutting Tools: Processing of WC–Co and Ti(C, N)–NiMo for Functional Cutting Tools.** He presented the solvent on granules 3D-printing, a technique invented in his lab to process cemented carbide parts. He demonstrated the fabrication of drilling tool bits made of WC with 12 % Co binder. Later he discussed the results of uniaxial pressed hardmetal inserts fabricated by complex pressing tool and hardmetal coating.

Later, A. Hadian (Empa/CH) presented his activities in the field of thermoplastic processing of hardmetals: **NbC-Based Cemented Carbides as a Potential Substitute for WC–Co Hardmetals: Effect of Metallic Binder and Post Heat Treatment on the Mechanical Properties.** After an overview of NbC based hardmetals research activities, he showed the potential of tool steel binder for niobium carbides.

In his study, he observed a significant effect of the sintering temperature on the microstructure and the final mechanical properties. It could be concluded that post-heat treatment is required to improve the final properties.

Before starting the lab tour, Prof. D. Penner (ZHAW/CH) presented the **Electrically Conductive Ceramics for High-Temperature Heating**. He demonstrated the fabrication of $MoSi_2$ heating elements by using thermoplastic shaping processes with a commercial binder system delivered by Krahn Ceramics GmbH/DE. Using alumina and feldspar the pest oxidation of $MoSi_2$ above 400 °C could be avoided, successfully. Using a water-soluble sacrificial moulds complex high temperature heating elements could be successfully achieved by injection moulding.

The meeting concluded with a lab tour, where the participants could visit the laboratory of Prof. Alberto Ortona. Especially the computationally designed heat and mass exchangers and the different Additive Manufacturing processing machines were of interest to the participants of the meeting.

The next expert meeting is planned for the end of November 2023 at ZHAW in Winterthur/CH. An exact date will be announced.