University Carlos III studies PIM of zirconium silicate

A recently completed ECOPIM research project undertaken by the University Carlos III de Madrid in collaboration with Spanish partners Guzman Global, based in Nules, and MIM-Tech Alfa, based in Eibar, has resulted in a new Powder Injection Moulding processing route to produce components from zirconium silicate ($ZrSiO_4$).

The new process developed under the ECOPIM project is said to use a feedstock binder system with a high percentage of soluble polymer which is more eco-friendly than conventional binders. The results of the project, which had the objective of finding new applications for zircon silicate in sectors such as automotive, aerospace, jewellery, telecommunications and machinery, were published in *Boletin de la Sociedad Española de Cerámica Y Vidrio* (Vol. 54, June 2015, pp 93-100) by authors Carolina Abayo, A. Jimenez-Morales, and J. M. Torralba.

The authors stated the raw $ZrSiO_4$ powder, grade ARMIN-05 supplied by Guzman Global, was obtained from mineral sands zircon silicate. The powder had a particle size distribution of 1.94 µm (D50) and 5.49 µm (D90) respectively; apparent density is 19.05%. The irregular morphology (Fig. 1) of the $ZrSiO_4$ powder contrasts with the normally spherical powder morphology used in Powder Injection Moulding. They studied PIM binder systems composed of Cellulose Acetate Butyrate (CAB), which is an alternative to polyolefin, and Polyethylene Glycol (PEG), a water-soluble polymer, to which was added stearic acid as surfactant and antioxidant phenothiazine.

Different grades of molecular weights (Mw) were used to study the influence of binder composition on the PIM process; PEG between 1.5 K and 20 K Mw and CAB between 20 K and 30 K Mw. It was stated that optimising binder system design is extremely important to avoid defects in the PIM parts at different production stages. It was established that a binder system based on high-Mw of CAB and low-Mw of PEG (binder B3 in Table 1) with a suitable rheological behaviour and successful solvent

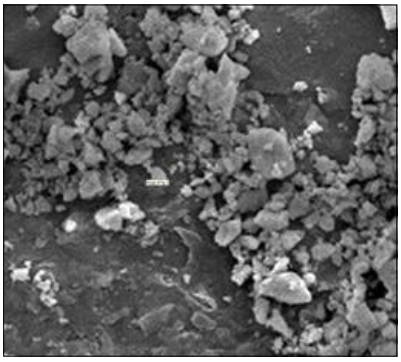

Fig. 1 Morphology of raw zircon powders obtained by SEM (From paper by C. Abajoa, etal.Boletin de la Sociedad Espanola de Ceramica y Vidrio, June 2015)

debinding has the potential to be cost efficient for PIM production of $ZrSiO_4$ components. This binder system is also eco-friendly through the use of a high percentage of soluble polymers and CAB which brings about zero balance of CO_2 emissions through its thermal degradation.

To fully test the B3 binder system, green parts having dimensions of 60 mm x 8 mm x 4 mm were injection moulded. Water solvent debinding was carried out from room temperature to 60°C followed by thermal debinding at up to 500°C, and sintering at 1500°C for 3 hr. The PIM processed $ZrSiO_4$ parts were found to be defect free. The sintered parts were tested for dimensional change, relative density by water absorption method and flexural strength obtained on a three-point bending testing machine. A competitive flexural strength was reported for the sintered PIM $ZrSiO_4$ test pieces.

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	CAB 30K	CAB 20K	PEG 20K	PEG 10K	PEG 4K	PEG 1.5K	SA	PTZ
B1		30	70					
B2	30		33.5	33.5			2.5	0.5
B3	30				33.5	33.5	2.5	0.5
B4		30	33.5	33.5			2.5	0.5
B5		30			33.5	33.5	2.5	0.5
B6		30	50	5	5	10		
B7		40	60					

Table 1 Binder compositions in vol% of the binder with different grades of molecular weights (From paper by C. Abajoa, etal.Boletin de la Sociedad Espanola de Ceramica y Vidrio, June 2015)

POWDERMET2016 Call for Papers issued

The Metal Powder Industries Federation (MPIF) has issued a Call for Papers for its POWDERMET2016 International Conference on Powder Metallurgy and Particulate Materials, Boston, Massachusetts, USA, June 5–8, 2016.

Authors are requested to submit abstracts for papers to be presented in the general technical sessions and poster programmes no later than September 18, 2015. Abstracts can address all aspects of Powder Metallurgy and particulate materials technology. The technical sessions will include the following categories:

- Design & Modelling of PM Materials, Components & Processes
- Particulate Production
- General Compaction & Forming Processes
- Powder Injection Moulding (Metals & Ceramics)
- Pre-Sintering & Sintering
- Secondary Operations
- Materials
- Refractory Metals, Carbides & Ceramics
- Advanced Particulate Materials & Processes
- Material Properties
- Test & Evaluation
- Applications
- Management Issues

The MPIF's Additive Manufacturing with Powder Metallurgy conference (AMPM2016) will be held in conjunction with POWDERMET2016.

www.powdermet2016.org