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SINTERING/MELTING OF $BATIO_3$ COATING BY LASER HEAT TREATMENTS

***N. Basile*[1], *A. Van Baekel*[1], *M. Gonon*[1], *F. Petit*[2], *C. Ott*[2], *F. Cambier*[2]**

[1] Université de Mons, Faculté Polytechnique, Service de Science des Matériaux, 56, rue de l'Epargne, B-7000 Mons (Belgium)

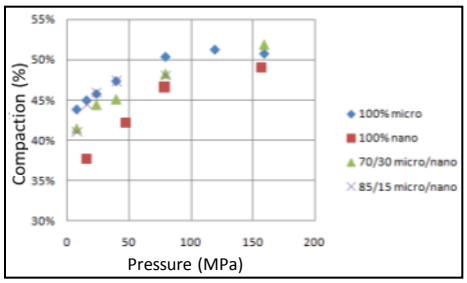
[2] Belgium Ceramic Research Centre, 5, avenue du gouverneur Cornez, B-7000 Mons (Belgium)

Purpose

The behavior of barium titanate powders (micrometric, nanometric and mix of micro+nano) under selective laser treatment (YAG 20 W max) is investigated. In a first stage, powder compacts are used in order to characterize the response of the powder according to the laser scan conditions (power %, spot speed mm/s and vectorization step µm). Then specimens simulating a capacitor geometry (alumina substrate / Pt electrode / $BaTiO_3$ thick coating) where prepared.

Preparation of $BaTiO_3$ powder compacts

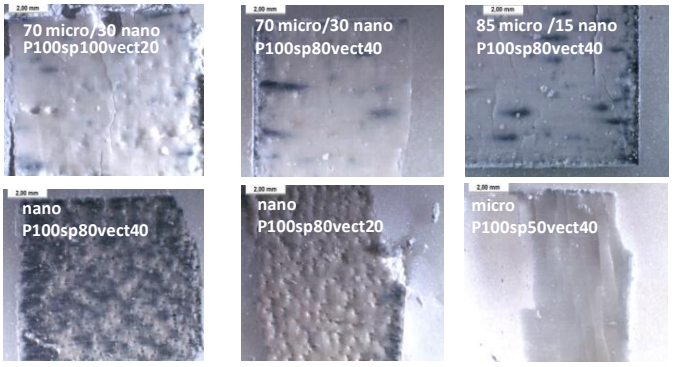
Compact of $BaTiO_3$powder (uniaxial pressure): 20 g, Ø 4cm



Evolution of the compaction in function of the pressure with 2 grades of powder (micro d_{50}=0,5µm d_{90}=2,3µm; nano d_{50}=50nm): →79 MPa good compact cohesion

Laser treatment on $BaTiO_3$ powder compacts

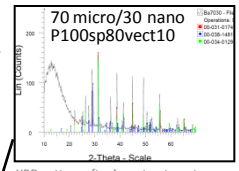
Figure on the right shows squares lased on the surface of a $BaTiO_3$ compact.
Figures below show these surfaces lased according to different scan conditions and powder characteristics.



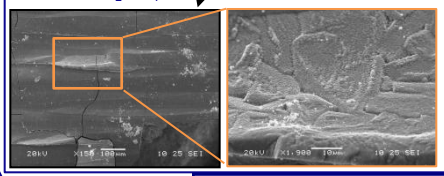
XRD/MEB investigations of lased surfaces

Initials powders:
JCPDS file
05-0626 $BaTiO_3$ quad.

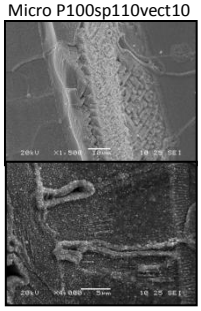
After treatment:
Amorphous phase
+ JCPDS files
31-0174 $BaTiO_3$ cub.
34-0129 $BaTiO_3$ hex.
38-1481 Ba_2TiO_4 ort.



XRD pattern after laser treatment



Micro P100sp110vect10



Amorphous phase
+ structure like dendrite
+ initials grains powder

Laser treatment of $BaTiO_3$ powder (micro) coatings deposited by spraying on alumina substrate

Figures below show SEM pictures of a $BaTiO_3$ coating after laser treatment at a speed of 200mm/s, a vectorization of 20 µm and a laser power of 100% on a surface of 1 x 1 cm².

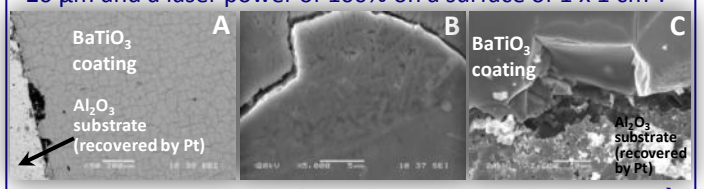
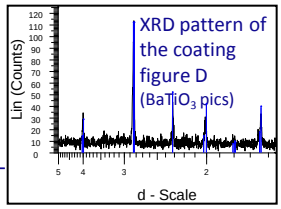


Figure A: Numerous cracks with a periodic distribution → thermal gradient at the rear of the beam scan and the also to the difference in expansion coefficient between the $BaTiO_3$ layer and the substrate.

Figure B: Dendrite like structure → the coating results of the melting and crystallization of the $BaTiO_3$ powder (confirmed by XRD)

Figure C: coating fairly dense (thickness of about 18 µm)



Conclusion

In order to create a microelectronic component, we have sprayed an aqueous ink of $BaTiO_3$ on alumina substrate recovered by platinum. Dense coatings adherents to the substrate have been realized. The powder melts and a partial crystallization appears during the cooling of the coating. We try now to create only a densification of the powder without melting on compact of $BaTiO_3$ powder. We hope to increase the densification with a mix of powder.

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