SINTERING/MELTING OF BATIO$_3$
COATING BY LASER HEAT TREATMENTS

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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

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 cm$^2$.

Figure A: Numerous cracks with a periodic distribution $\rightarrow$ 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 $\rightarrow$ 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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