ABSORBANCE ENHANCERS OF CERAMIC POWDERS FOR SLS/M

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1. 8YSZ Powder Synthesis

The ceramic powder used is 8% Yttrium Stabilized Zirconia (Figs. 1 and 2), synthetized and tailored as follows:

Solution → Combustion → Grinding → Deagglomeration → Drying → Sieving → Spray drying → Thermal Treatment → Dopants

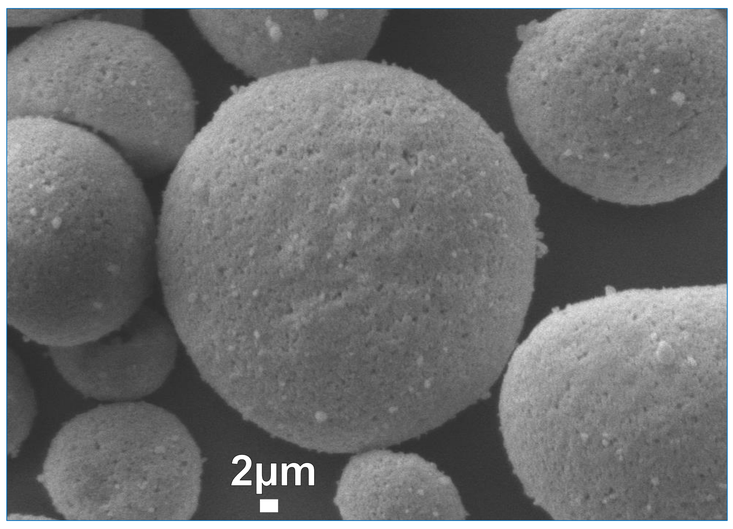


Fig. 1 – Spherical morphology of final 8YSZ MT.

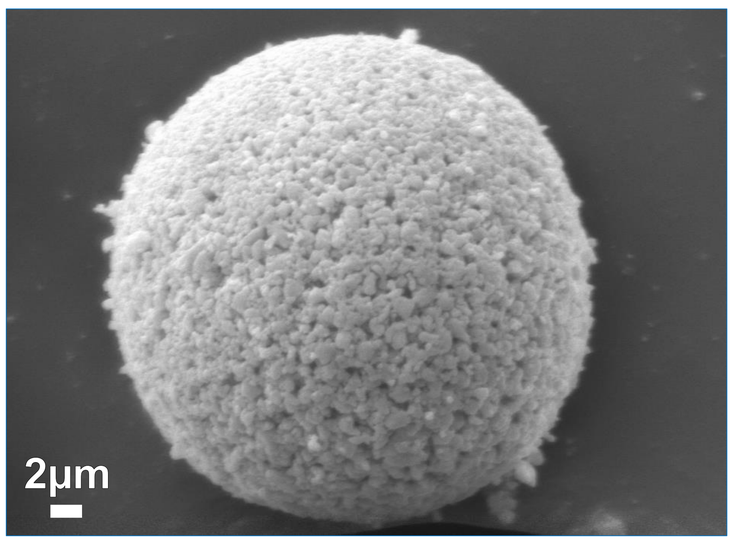


Fig. 2 – Detail over the nanoparticles.

2. Absorbance Enhancer Dopants

The alternative dopants are SiC, TiC, Carbon Black and Graphite, with the respective particle sizes (d50) displayed on the table 1 among other values:

Table 1 – Dopants and ceramic powders particle size.

Powder	Particle Size d50 (µm)
SiC	0.55
TiC	0.85
Carbon Black	1.7
Graphite	8
8YSZ MT	27
8YSZ Lit.[3]	19
Graphite Lit.[3]	14

3. 8YSZ / Dopants Mixture

The method for mixing the ceramic powder with the dopant is crucial. It cannot break the spherical particles formed by spray drying, which is the main characteristic to achieve **good flowability**.

Rough mixing → Flowability

In general, a Carr Index around 15 is considered an indication of excellent flowability **(Carr Index $_{8YSZ\ MT}$ = 17,3)**.

4. Initial and Final Absorbance

The objective is to reach around **60 %** of absorbance using the minimum amount of dopant possible. Oxides usually have very low absorbance under Nd:YAG lasers exposure (Fig. 3).

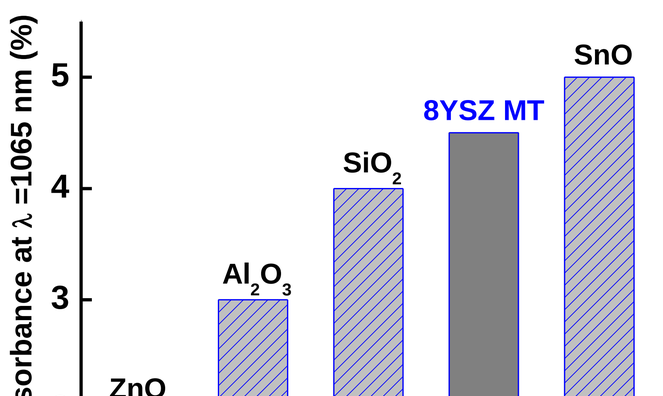


Fig. 3 – Pure oxides absorbances[4] at λ = 1065 nm.

Samples were prepared with dopants proportions of 0.25 and 0.75 wt.%. The absorption/amount ratios are displayed at Fig. 4.

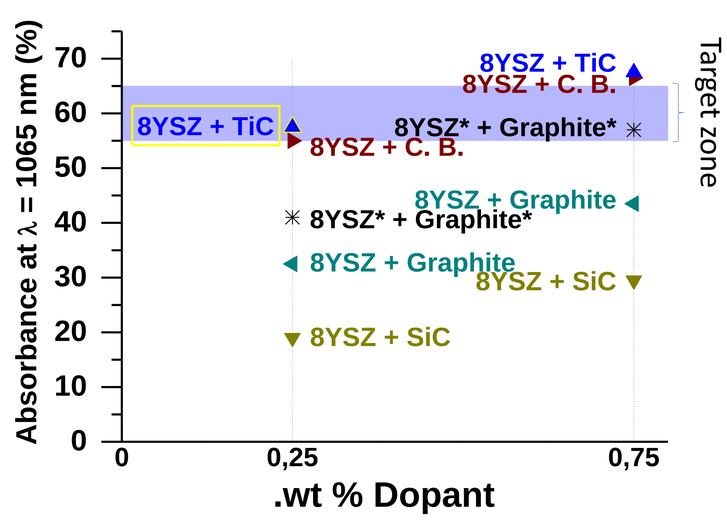


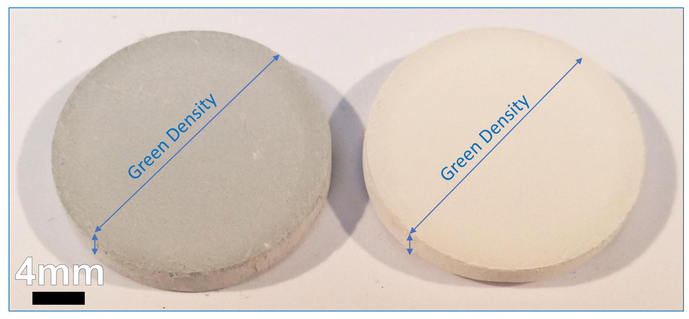
Fig. 4 – Doped 8YSZ absorbances at λ = 1065 nm.

The powder containing 0.25 wt.% TiC was selected to be pressed and sintered to check compatibility with 8YSZ.

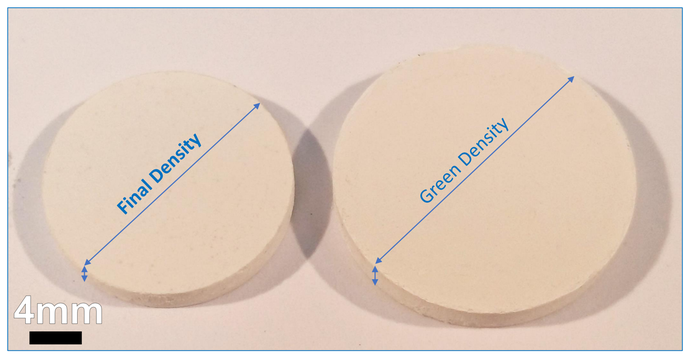
5. Validation by Conventional Sintering

The feasibility of using 0.25 wt.% TiC in 8YSZ during conventional sintering was investigated as follows:

Cold pressing → 8YSZ / TiC, 8YSZ



1400° C, 1500° C, 1600° C



Relative Density

The sintering results (Fig. 5) indicate that TiC, even in a small amount of 0.25 wt.%, retains the decrease in relative density with the temperature increase.

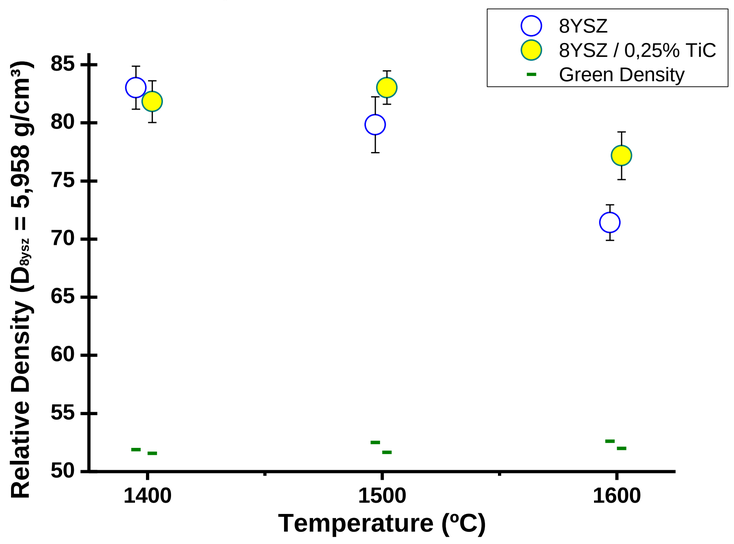


Fig. 5 – Relative density of pure and 0.25 wt.% doped 8YSZ.

6. Conclusions

The best absorbance/amount ratio was from the sample with 0.25 wt.% TiC. This sample was also conventionally sintered and approved to further tests with SLS/M.

[3] FERRAGE L., *Elaboration d'un assemblage céramique-métal par fusion/frittage sélectif(ve) d'un lit de poudre à l'aide d'un laser Nd :YAG (2018).* [4] Tolochko N. K., Absorptance of powder materials suitable for laser sintering (2000).

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