SYNTHESIS OF ALUMINA POWDER WITH GOOD SINTERABILITY

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ABSTRACT

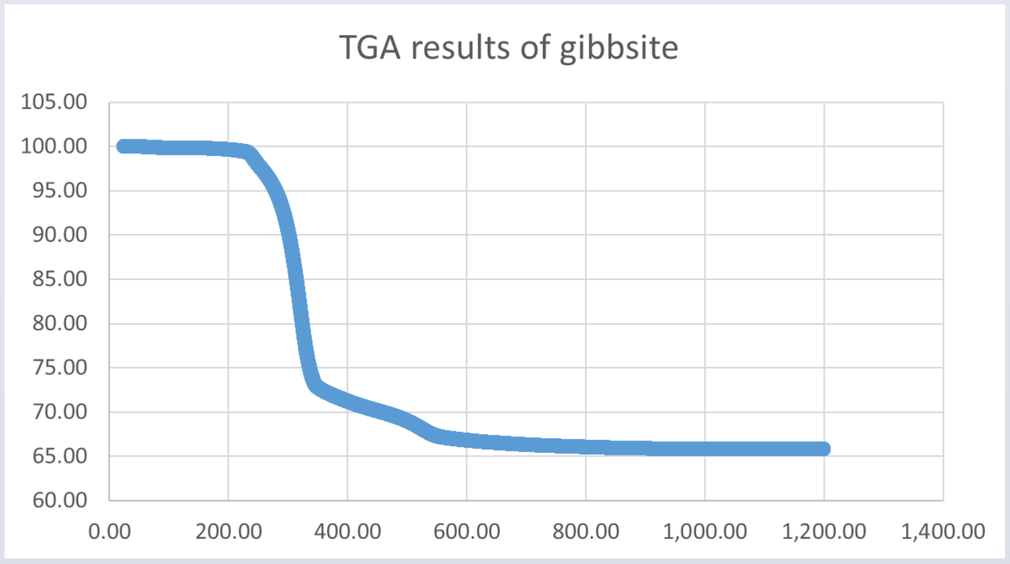
Rockets are a critical component of any country's military capabilities. Currently, seeker domes in the front of the rockets are composed of a transparent ceramic material, made of single crystalline, a material that is durable, yet very expensive. Our goal is to use polycrystalline with the densest alumina to achieve the same durability in domes at a lower cost.

To achieve this, we applied **sintering** (Patricia et al., 1999; Rubart du Merac et. al., 2013), a common process of transforming powder into a solid body by using heat. To produce the most sinterable alumina (Al_2O_3), **we resorted to domestic sources and used gibbsite, a form of $Al(OH)_3$, as a potential alumina powder.**

OBJECTIVES

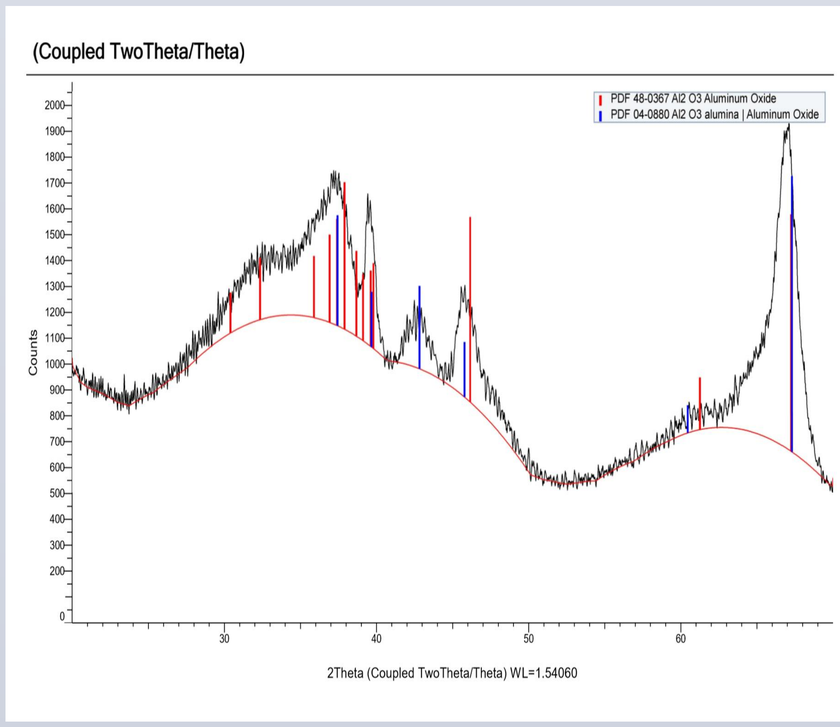
The objective of this project is to produce a cheaper, polycrystalline material to be used in rocket domes without sacrificing the durability of the material. For this, we aim to sinter alumina powder and achieve the highest density.

PROJECT DETAILS



Three powders generated from three temperatures:
700 °C, 1200 °C and 1125 °C

POWDER 1: GIBBSITE IS HEATED UP TO 700 °C

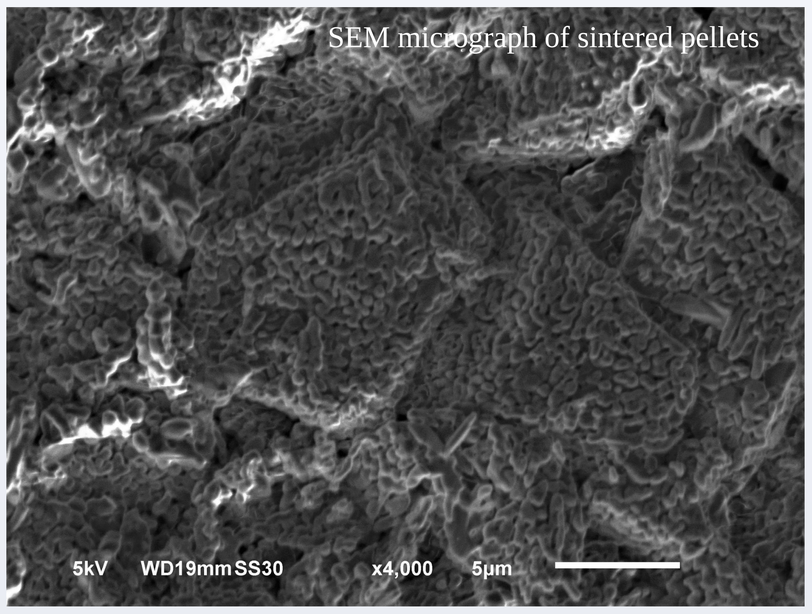


First sample: heated to 700 °C.

Result: different phases of alumina

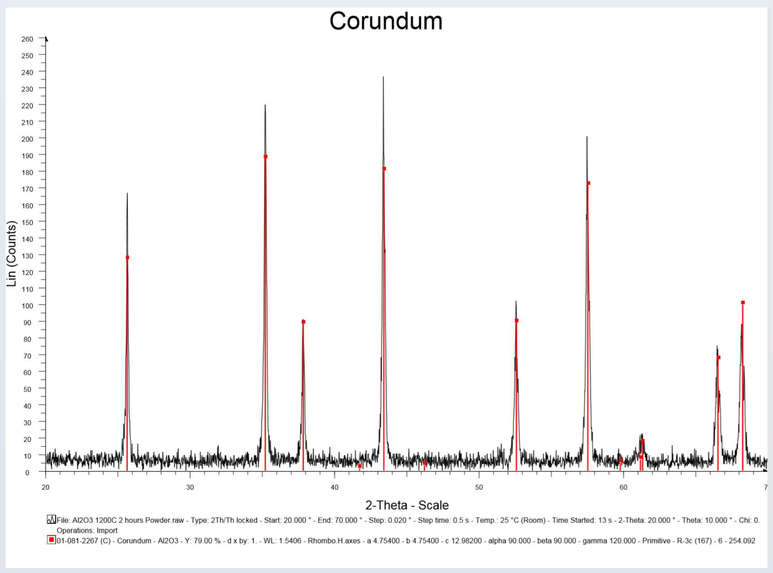
-a tetragonal structure, the α phase

-cubic structure, the γ phase.

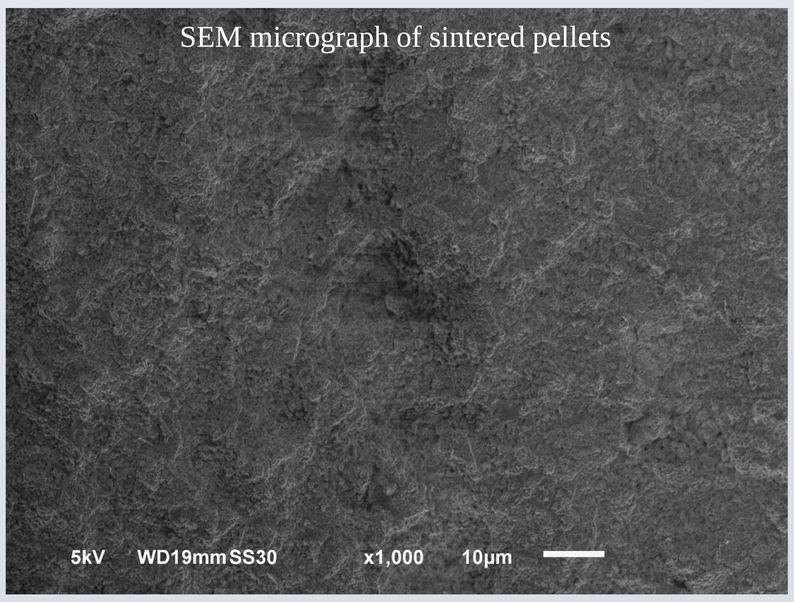


Sintered at 1400 °C for 23.5 hours.
Outcome of sintering:
Density: low, <3g/ cm^3

POWDER 2: GIBBSITE IS HEATED UP TO 1200 °C



Second sample: heated to 1200 °C.
Result: single phase of alumina,
- the α phase



Sintered at 1400 °C for 23.5 hours.
Outcome of sintering:
Density: better than the first powder, ~3g/ cm^3

POWDER 3: GIBBSITE IS HEATED UP TO 1125 °C

Third sample: heated to 1125 °C.
Result: single phase of alumina,
- the α phase
Sintered at 1400 °C for 2 hours.
Density: The best results so far, >3g/ cm^3

CONCLUSIONS

- We lowered the cost of the material used for the dome, objective achieved
- But ideal densities are not yet reached, still working on it

REFERENCES

- Merkert, Patrica; Horst Hahn and Jiirgen Rodel. 1999. Sintering Behavior of Nanocrystlalline. *NanoStructured Materials*, 12: 701-704.
- Rubat du Merac, Marc; Hans-Joachim Kleebe; Mathis M. M€uller and Ivar E. Reimanis. Fifty Years of Research and Development Coming to Fruition, Unraveling the Complex Interactions During Processing of Transparent Magnesium Aluminate Spinel. *The American Ceramic Society* 96(11): 3341-3365.