

PhD proposal

Study about the effect of electric field during the reactive SPS sintering of AION

The goal of the PhD is to understand the physical phenomena which take place during the reactive sintering of a mixture of AlN (Nitride of Aluminum) and Al₂O₃ (Alumina) to form AION.



AION (Oxy nitride of Aluminum) is a material with really interesting optical (High optical transmission (>85%) near-UV to mid-IR wavelengths) and mechanical properties. Few companies have the know how to make it and the process is based on reactive sintering (easiest and least expensive method): high temperature and pressure treatment of a mixture of Al₂O₃ and AlN powder. During this treatment a chemical reaction occurs to form AION.

During preliminary studies using a spark plasma sintering machine (left figure), it has been shown that the sintering behaviour is different if an electric field is applied on the sample. The goal of the PhD is to study the influence of electric field on the sintering process in order to optimize the process. Typically, the temperature and pressure level might be decreased thus decreasing the energy consumption.

To have a better insight on the chemical reaction occurring during the sintering, our goal is to modify an existing high pressure/high temperature furnace in order to decouple the temperature level and the electric field applied to the sample to be sintered. Also the electrical resistance of the sample will be measured during the sintering process. The experimental development of such a measurement is part of the internship. This new experimental set up will allow to monitor the chemical reaction during the sintering. After the sintering process, the samples will be characterized using several methods (electronic microscopy, DRX, optical analysis...).

A model has to be developed to account for the chemical reaction, species diffusion and the influence of the electric field.

Experimental and simulations will be used to understand and optimize the sintering process assisted by an electric field.

The student will be supervised by Dr. Sandrine Cottrino and Pr. Patrice Chantrenne.

The PhD will take place at MATEIS laboratory and begin on October the first 2023.

The PhD will be financed by a grant given by the French government. The student will have to do a presentation in front of the selection committee.

To apply, please send a mail to:

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and

- Patrice Chantrenne, Professor, patrice.chantrenne@insa-lyon.fr

with a CV and the all the transcript of record (bachelor and master graduation).