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THE FRENCH AEROSPACE LAB

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# PROPOSITION DE POST-DOCTORAT

**Intitulé : MgO-Y2O3 nanocomposite ceramics for high temperature infrared window applications**

Référence : **PDOC-DMAS-2024-02**
*(à rappeler dans toute correspondance)*

| **Début du contrat : October 2024** | **Date limite de candidature :** |
|---|---|

**Durée : 18 months**

**Mots clés**

Ceramic processing, nanocomposites, optical applications, high temperature transparency

**Profil et compétences recherchées**

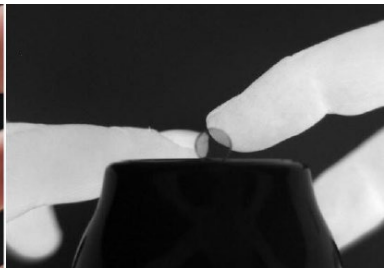
Materials sciences, ceramics

**Présentation du projet, contexte et objectifs**

This post-doc will be part of a european project. For a window evolving in severe conditions, its temperature can increase up to hundreds of degrees or beyond. However, at high temperature, the transparency range of the window becomes narrower in the infrared. This has two main consequences: the light has more difficulties to go through the window and, because of the Kirchhoff equivalence principle, its own light emission increases too. These phenomena are important problems when using an electronic light detector as a camera behind such a window.

The window material can be a transparent ceramic. In the 3-5 µm range, which is an atmosphere transparency band, most of the oxide compounds are transparent at room temperature and many windows are made of sapphire (alumina), $MgAl_2O_4$, … Nevertheless, when the temperature is increasing, these materials start to absorb and emit more and more in that band which can be a problem above a certain threshold because of a to small signal-to-noise ratio on the detector.

MgO and $Y_2O_3$ are oxides which are transparent farer in the infrared than the previous compounds but their thermomechanical properties are not so good and cannot be used as an aerospace window for example in severe conditions. In the contrary, the mixture of MgO and $Y_2O_3$ into a nanoceramic enhances its thermomechanical properties which become better than in each compound separately. Moreover, the IR transparency of such a ceramic stays as wide as in the separated compounds. In recent ONERA studies, we demonstrated that thanks to the wider tansparency of that ceramic, even at high temperature, the 3-5µm band is only sligthly affected. However, until now, only small samples have been processed and bigger samples are needed to performed further mechanical, thermal and optical characerizations.



**The goal of the present work is to optimize the whole ceramic process to increase the sample size and then to characterize them.**

So the work can therefore be described as follows:

1/to process $MgO/Y_2O_3$ nanoceramics following different steps

a)powder processing by the sol-gel process

b)sample sintering using the FAST (Field Assisted Sintering Technique) technique or natural sintering and then using a HIP (Hot Isostatic Press)

2/To characterize them:

a)Scanning Electron Microscopy, Grain size analysis, porosity

b)optical transmission at room temperature and at high temperature

c)thermal and mechanical properties,…

The present study is very motivating because it takes place in a lab with unique (in France or even in Europe) benches in term of capabilities. It also participates in the development of high performance materials.

**Collaborations extérieures**

**Laboratoire d'accueil à l'ONERA**

Département : Matériaux et Structures

Lieu (centre ONERA) : Chatillon and Palaiseau

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