

Review of the habilitation thesis

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**Habilitation Thesis: Nanostructure Oxyfluoride Glass-Ceramics:
Relation between synthesis, processing and structural and
optical properties.**

The habilitation thesis consists of a summary of 69 pages long including introduction, overview of the results and conclusions. In this research Glasses and GCs have been prepared by melt quenching (MQ) and sol-gel (SG) methods, providing a comparison respecting crystallisation mechanism, structure, dopant incorporation in the nanocrystals and optical properties. In this sense is proposed the optical characterisation of RE-doped materials using photoluminescence (PL) in the GCs samples compared to the untreated glass and xerogel samples.

The thesis provide a very good general overview of the activities of Dr. José Joaquín Velázquez García in the field of the Nanostructure Oxyfluoride Glass-Ceramics. Therefore, He is co-author of 46 scientific papers published in journals with a good quality and indexed in the Journal Citation Report.

The habilitation thesis includes several new results and the most important among them, in my opinion, are:

1. **Preparation of NaGdF₄ and NaLuF₄ transparent GCs** prepared by MQ method from two oxyfluoride glass compositions.

2. **Characterization of the crystallization mechanisms.** The crystallization mechanism of the glasses prepared by both, MQ and SG methods, are based on a diffusion-controlled process. However, the nature of this diffusion controlled process is different in each processing method. While for MQ glasses the diffusion-controlled process starts from a constant number of nuclei followed by crystal growth, for SG samples this process occurs through a chemical decomposition followed by crystal precipitation.

3. **Explanation of the Incorporation of the RE ions into the fluoride NCs during the crystallization.** This process is facilitated by the existence of already RE enriched phase-separation in the precursor glasses.

4. **Analysis of the size of the NC.** NCs size increases with treatment time at a fixed temperature until an asymptotic or constant value in the range 8-50 nm is reached, the value of which depends on the glass composition and crystal phase.

In my opinion, the thesis and the high experience of the Dr. José Joaquín Velázquez García confirm his level for the habilitation in this field.

However, I have several questions to the author of the habilitation thesis:

1. How the author could estimate the percentage of rare earth ions in the different phase (glass or nanocrystal) in the GC samples?

2. **In page 35.** I suppose that the ET efficiency for the sample codoped with 0.5% Pr³⁺-2% Yb³⁺ is obtained comparing the lifetimes with the sample only doped with Pr³⁺. Which is the lifetime used for the sample doped with 0.5% of Pr³⁺ (this decay curve shows a non-exponential behaviour).
3. **In page 37.** How the author has confirmed the energy transfer from Gd³⁺ to Eu³⁺? The Eq. (8) only explains the dynamic of the Eu³⁺ ions.

In La Laguna (Spain), 15th March, 2022.

Signed: Dr. Inocencio R. Martin.

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