Synthesis of Gadolynium Orthoferrite thin layers

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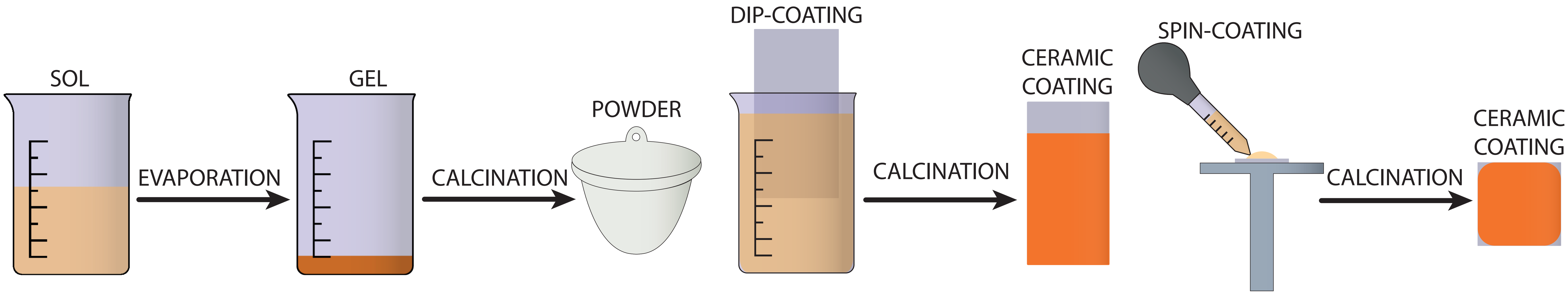
INTRODUCTION

Orthoferrites are a class of perovskite-type materials with the general formula $RFeO_3$, where R stands for rare earth element [1]. They are most interesting for their magnetic and electronic properties [2]. In this work, an aqueous sol-gel synthesis method [3] was adapted to obtain gadolinium orthoferrite powders and coatings.

- **POWDER** obtained by sintering the gel.
- **COATINGS** on silicon made by **DIP-COATING** and **SPIN-COATING** processes.
- **ETHYLENE GLYCOL** and **CITRIC ACID** were employed as the complexing agents.



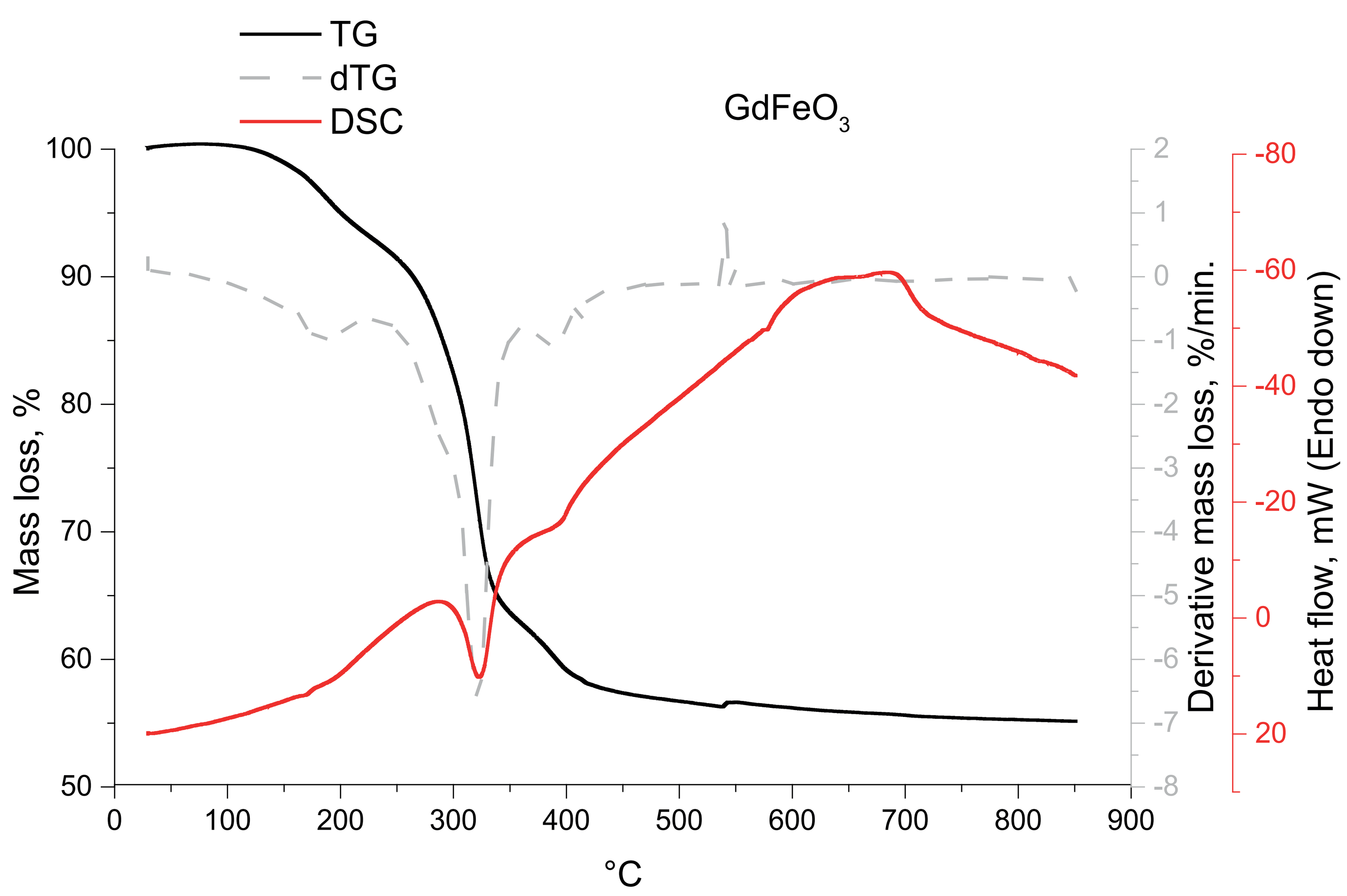


Fig. 1. TG/DSC measurements

TG/DSC results

Thermogravimetric and differential scanning calorimetry measurements were carried out for the ethylene glycol gel.

Key findings:

- Mass loss up until and including the first minor peak (up to ~200°C) most likely corresponds to the loss of moisture and perhaps some organics.
- The first major peak at around 320°C corresponds to the burning of organic materials and decomposition of nitrates.
- The heat flow change between 600-700°C might indicate the formation of the final phase of the compound.

X-ray diffraction results.

- XRD measurements showed that pure powders could be obtained when using citric acid as the complexing agent (otherwise the compound was not monophasic).
- As for coatings, only small peaks corresponding to the desired phase were visible for dip-coating, none for spin-coating. Surprisingly, coatings made by dip-coating using citric acid and ethylene glycol did not show noticable differences despite the differences when using these complexing agents for powders.
- The most intense peak corresponded to an unidentified secondary phase at around 2theta=29-29.5°. There were other intense unidentified peaks visible, most likely corresponding to the same unidentified phase. However, the database did not provide any reasonable matches, and the most likely secondary phase candidates (namely, Gd_2O_3, Fe_2O_3, $Gd_3Fe_5O_{12}$).

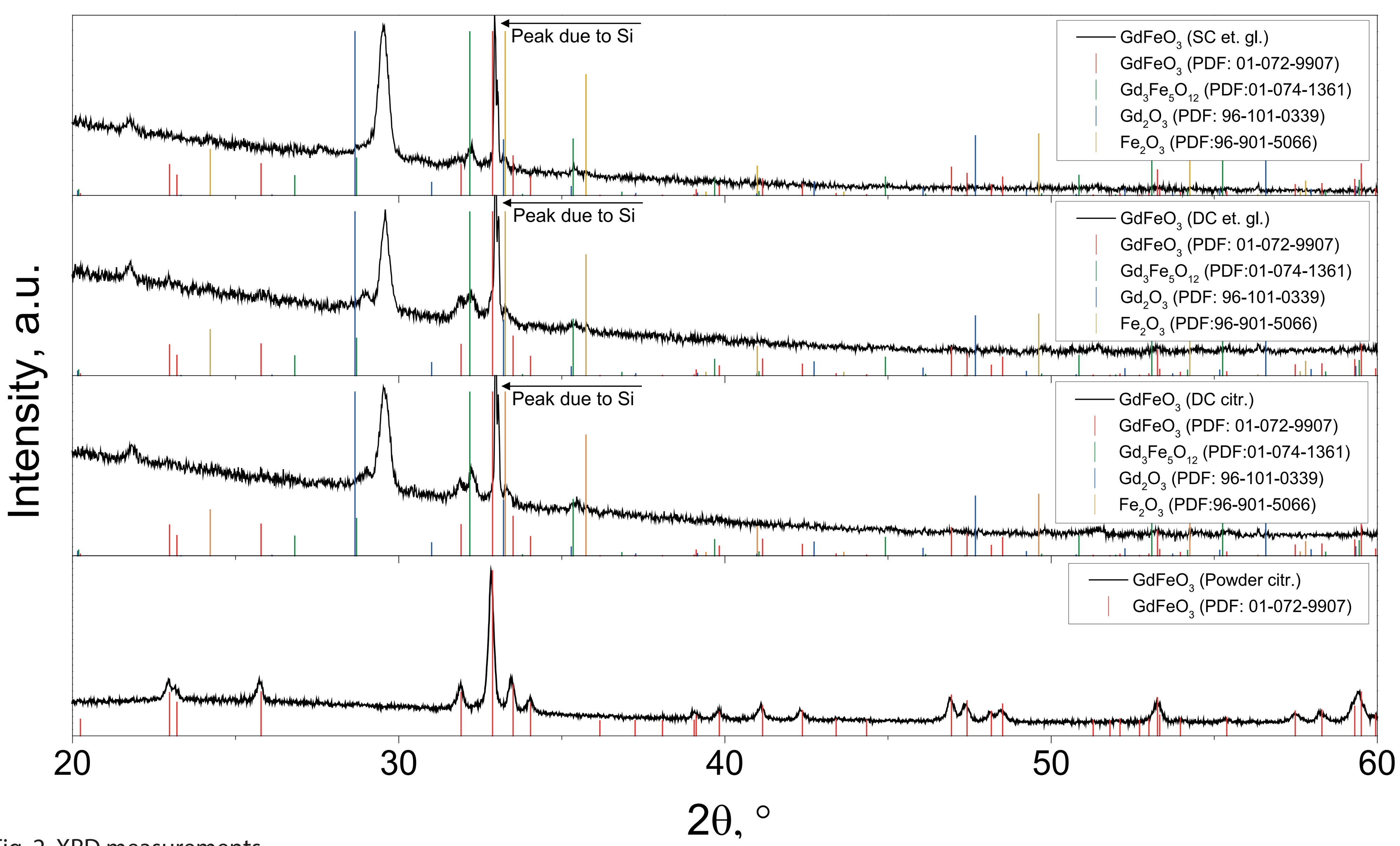


Fig. 2. XRD measurements

References:
1. R. White "Review of Recent Work on the Magnetic and Spectroscopic Properties of the Rare-Earth Orthoferrites" *Journal of Applied Physics* **40(3)** p. 1061-1069 (1969)
2. C. Zhao et al. "The multi-ferroelectricity in neodymium ferrite with perovskite structure" *Journal of Materials Science* **56(17)** p. 10488-10493 (2021)
3. J. Januskevicius et al. ""Aqueous Sol-Gel Synthesis of Different Iron Ferrites: From 3D to 2D *Materials* **14(6)** 1554 (2021)

Acknowledgements. This work was supported by a Research grant BUNACOMP (No. S-MIP-19-9) from the Research Council of Lithuania