SYNTHESIS OF GADOLINIUM ORTHOFERRITE THIN LAYERS

Justinas Januškevičius[1*], Ieva Čėsnaitė[1], Živilė Stankevičiūtė[1], Aldona Beganskienė[1], Aivaras Kareiva[1]

[1] *Faculty of Chemistry and Geosciences, Vilnius University, Vilnius, Lithuania*
* *justinas.januskevicius@chgf.vu.lt*

The field of new magnetic material development has received a lot of attention in recent years. Research into potential multi ferroic and spintronic materials is still picking up speed and even beginning to intersect [1]. This recent development has been driven by several factors – foremost among them the large potential for technological applications and the advancement in both the theoretical and experimental knowledge base [2–4]. Orthoferrites are a class of materials that are of potential interest in this area, with different orthoferrites showing signs of antiferromagnetic, ferrimagnetic and a whole spectrum of related magnetic properties in addition to ferroelectric properties [5]. It is a group of perovskite-like structure materials with a general formula of $RFeO_3$, where R is generally one of the rare-earth elements. The original perovskite structure is cubic, but easily deformed depending on the sizes of constituent atoms, with most orthoferrites having orthorhombic or similar structure. This formability of orthoferrites is one of their most interesting features, allowing a wide range of desired modifications to their structure and properties.

In this particular work, gadolinium orthoferrite was chosen as the synthesis target using a simple and adaptable aqueous sol-gel synthesis method. This was done to find a simple, inexpensive synthesis method and to then produce coatings on silicon substrates by using a dip-coating process. Fabrication of coatings is important for two main reasons. Firstly, thin layers can have unique properties as compared to bulk material. Secondly, many applications, especially electronics-related, require coatings of materials rather than powdered ceramics.

Initially, metal nitrates and ethylene glycol were used as starting materials for the sol-gel process [6,7]. Sol was produced, then separated into two parts – one for the production of powders, the other for dip-coating. The sol that was kept for production of powders underwent gelation, with part of the gel being used for thermogravimetric analysis. The rest of the gel was calcinated to obtain ceramic powder. After this, the rest of the sol was used to carry out a dip-coating process to obtain coatings of the orthoferrite. XRD was carried out in both cases. For the powders, it showed that the samples were not monophasic gadolinium orthoferrite, with small peaks of both constituent metal oxides visible. As for the coatings – it showed that while some desired phase formed, secondary peaks were about the same intensity or higher. Taking these results into consideration, synthesis was repeated with citric acid instead of ethylene glycol, which resulted in single phase powder, but still mixed phases for the coatings.

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