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SOL-GEL SYNTHESIS AND SUBSEQUENT DIP-COATING ON SILICON OF YTTRIUM, TERBIUM IRON PEROVSKITES AND YTTRIUM IRON GARNET

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Terahertz spectroscopy for material research is an emerging field in science. New materials need to be created for the construction of devices capable of performing such tasks [1]. Among such materials – yttrium, terbium iron perovskites are promising due to their crystal structure and unique properties, including potential multiferroic behavior [2, 3], as well as yttrium iron garnet which also has been reported to display multiferroic behavior, and can already be used as a tunable microwave filter [4, 5]. In this study, the thin films of these materials were fabricated on silicon substrate using the sol-gel dip-coating [6] method.

The precursor solutions were prepared by dissolving stoichiometric amounts of yttrium and iron nitrates in water, then adding 1,2-ethanediol as a complexing agent. A part of each precursor solution was separated, then evaporated to obtain a gel, which was then heated at 1000 °C to obtain powders. The remaining solution was used for the dip-coating procedure, after mixing it with 3% polyvinyl-alcohol at a ratio of 1:1. The dip-coating was performed on p-type and undoped silicon substrates, with an immersion speed of 85 mm/min, holding time of 10 seconds, and withdrawal rate of 40 mm/min. The dip-coating procedure was repeated 5 and 15 times for different samples, drying the sample at room temperature for 30-60 min. each time, then heating it to 500 °C, holding this temperature for 1 h using a heating rate of 1°/min. After the final layer was deposited, the samples were heated at 1000 °C for 10 h, using a heating rate of 1 °C/min. The prepared coatings were investigated using X-ray diffraction (XRD) analysis and scanning electron microscopy (SEM). The powders were also investigated using XRD and thermogravimetric analysis.

The results revealed that while the powders were of a single phase and had well-defined X-ray diffraction peaks, using the same solution for dip-coating yielded coatings of mixed phases.

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