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Fabrication and Magnetic Properties of DLI-CVD Deposited $LiFe_5O_8$ Thick Films for Microwave Device Applications

Liming Shen[1], Andrew Wang[1], Ning Li[2], Ningzhong Bao[1], Neha Pachauri[1], Sebastian Schafer, Dipanjan Mazumdar[1], Tim Mewes[1], Tonya Klein[2], and Arunava Gupta[1,2]

[1]MINT Center, [2]Department of Chemical & Biological Engineering and The University of Alabama, Tuscaloosa, AL, USA

Abstract

Ferrimagnetic ferrites are one of most important class of microwave materials. Spinel nickel ferrite and magnesium ferrite have long been used by microwave industry. However, the wide application of these two ferrites is limited by their low Curie temperature and low magnetization. Lithium ferrite offers the performance advantages over other spinel ferrites and is competitive with the garnets for microwave applications. Growth of high quality and thick (10-100 μm) ferrite films is essential for the fabrication of microwave devices. In this work, the growth of single crystal lithium ferrite ($LiFe_5O_8$, LFO) films with high growth rate by direct liquid injection chemical vapor deposition (DLI-CVD) is investigated. The liquid precursor source for injection was prepared by dissolving corresponding metalorganic precursors into a solvent. In our case, anhydrous Li(acac) and $Fe(acac)_3$ (acac=acetylacetonate) (mole ratio 1:5) were dissolved in N, N-Dimethylformamide (DMF). The as-prepared precursor solution was fed into a commercial vaporizer system through a liquid mass flow controller (10 g/h range). Epitaxial growth of LFO films on MgO (100) were confirmed using X-ray diffraction. Out-of-plane and in-plane texture were analyzed by ω scan and φ scan. Field emission scanning electron microscopy (FE-SEM) and atomic force microscopy study showed dense and atomically smooth LFO films. Films deposited at 600 ^oC showed saturation magnetization of 312 emu/cc (bulk value, 320 emu/cc). The growth rates of the LFO films were in the range of 0.6~0.8 μm/h under our experimental conditions.