

Synthesis of novel Lithium Adducts as Precursors for Lithium Niobates by DLI-MOCVD

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LiNbO₃ material is mainly used for optoelectronics applications. Generally, LiNbO₃ and its related materials are prepared from high temperature processes, such as single-crystal Czochralski growth [1] and Stepanov growth [2]. Nevertheless, applications for quantum photonics, surface acoustic wave devices, ferroelectric based devices etc. require the availability of LiNbO₃ in thin films form. To this aim various techniques have been applied such as capillary liquid epitaxial technique [3], RF- magnetron sputtering [4], spin-coating [5] and MOCVD [6]. MOCVD represents one of the most appealing processes in view of its easy scalability, but its application requires the use of precursors with appropriate mass transport properties.

In this work, we report on the syntheses, through single step reaction, of novel adducts of lithium hexafluoroacetylacetonato {Li(hfa)} with polyethers (monoglyme = {CH₃OCH₂CH₂OCH₃}, diglyme = {CH₃O(CH₂CH₂O)₂CH₃}, triglyme = {CH₃O(CH₂CH₂O)₃CH₃} and tetraglyme {CH₃O(CH₂CH₂O)₄CH₃}. They have been characterized by elemental analyses, FT-IR spectroscopy, ¹H and ¹³C NMR. Single crystal X-ray diffraction studies provide evidence of interesting coordination moieties [7]. Lithium Niobate was deposited on C – plane sapphire by using DLI-MOCVD reactor.

The FT-IR transmittance spectrum of the “Li(hfa)monoglyme” shows the peaks at 1674 cm⁻¹ and at 1560 cm⁻¹ associated with C=O stretching and C=C stretching, respectively, of the β-diketonate ligand. The broad band observed in the 1000-1300 cm⁻¹ range may be associated with absorptions of the polyether C-O bending and/or stretching overlapped with the C-F stretching. The C-H glyme stretching modes, lying in the 2800-3000 cm⁻¹ range, overlap with nujol features. In fact, the nujol shows peaks at 2923 cm⁻¹, at 1461 cm⁻¹ and at 1377 cm⁻¹. The spectrum also shows small peaks at about 3700 cm⁻¹, likely due to free lattice water molecules.

The mass transport properties of these adducts have been investigated through thermogravimetric (TG) analysis. The TG curve of the “Li(hfa)monoglyme” shows a step mass loss with a residue of 6% at 338 °C. Thermal analysis data revealed a discrete behavior, when precursors are used in a suited temperature range, regarding conventional MOCVD applications, while its solubility and clean decomposition make these complexes interesting precursors for liquid assisted processes such as liquid-delivery and aerosol-assisted MOCVD or sol-gel applications.

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