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MgB_2 Narrow Film Fabrication Using Pulsed Beam Deposition: A Short Communication

Mehaboobi Khan*

Department of Physics, Louisiana State University, Baton Rouge, LA, USA

Introduction

Magnesium diboride (MgB_2) with the superconducting change temperature Tc=39 K has an extraordinary potential for superconducting electronic applications cooled with fluid hydrogen (LH2) option in contrast to fluid helium-based cryogenic frameworks. Notwithstanding its somewhat high Tc, MgB_2 shows a great deal of captivating properties, for example, a straightforward layer structure, lower anisotropy, and longer intelligence length, when contrasted and cuprate high-Tc superconductors [1]. Also, the straightforwardness of the grain limits to current stream and the wealth of Mg and B offer the chance of utilizing MgB_2 for gadget applications.

Description

Epitaxial MgB_2 films empower the creation of the superconducting electronic applications, for example, superconducting indicators (progress edge sensors (TES) and superconducting burrow intersections (STJ)), advanced circuits, and diodes [2,3]. Enormous headway has been made upon the fruitful utilization of an assortment of testimony methods, like sub-atomic shaft epitaxy (MBE), beat laser statement (PLD), electron bar dissipation (EBE), crossover physical-compound fume statement (HPCVD), receptive vanishing and magnetron faltering. Two of the main necessities for the manufacture of MgB_2 dainty movies are: (I) to give an adequately high Mg fume tension for stage soundness of MgB_2 and (ii) to wipe out the leftover oxygen during the slender film combination in view of the great responsiveness of Mg to oxidation. MgB_2 films have been created through the PLD strategy not long after the disclosure of superconductivity in this material [4].

KrF (λ=248 nm) excimer lasers are widely used for PLD due to their high photon energy and light intensity. However, these excimer lasers are costly and use poisonous halogen gases for excitation. A feasible way to overcome these drawbacks would be to use a Nd:YAG (neodymium-doped yttrium aluminium garnet; Nd:Y3Al5O12) solid state laser instead. The Nd:YAG laser is highly stable and safe compared with excimer lasers, which use toxic gas. The fundamental wavelength of the Nd:YAG laser is 1064 nm. However, ultraviolet light can be generated by changing harmonic crystals to the fourth harmonic of the Nd:YAG's fundamental wavelength (λ=266 nm). At this wavelength, the Nd:YAG laser has a photon energy comparable to the KrF excimer laser's fundamental mode (λ=248 nm) [5]. The Nd:YAG laser also has additional advantages over the excimer lasers associated with their low installation, maintenance costs, and compact footprint. Hence, the Nd:YAG laser could be a potential alternative to excimer lasers for the PLD system. However, there are only few reports on MgB2 films fabricated by the Nd:YAG laser. In this paper, we report the fabrication of superconducting MgB2 thin films via an in situ PLD process using the fourth harmonic of the Nd:YAG laser. The influence of the Mg–B target composition on Tc of the films is investigated. We also present the structural and superconducting properties of the obtained MgB2 films.

The common creation interaction of MgB_2 flimsy movies comprises of a forerunner, become by the PLD technique at room temperature, and a postannealing cycle. The postannealing processes are delegated: (I) *ex situ*, which is acted in a metal cylinder under a Mg climate after the antecedent testimony in a chamber and (ii) *in situ*, which is acted in a similar chamber as the statement chamber for the forerunner films under vacuum, Ar or Ar/4%H_2 environment. The MgB_2 films created with a forerunner, become by the PLD strategy, and *in situ* postannealed (*in situ* PLD process) showed a zero-field Tczero of 29 K and a self-field Jc of 2 × 105 A cm-2 at 5 K.

Conclusion

Jcab (˚T) of MgB2 film #2 is estimated to be 0.9 106 A cm2 at 20 K based on attractive hysteresis estimates. According to the vehicle assessment in the rakish dependency on Jc in the attractive field, MgB2 film #2 has greater Jc at=90° (H/film surface), which could reflect the granular grain structure. By calibrating the creation interaction, we intend to get greater superconducting characteristics. Our findings show that the *in situ* planning methodology with Nd: YAG laser cycles are advantageous for the production of superconducting devices over the excimer laser process.

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Not applicable.

Conflict of Interest

There is no conflict of interest by author.

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***Address for Correspondence:** Mehaboobi Khan, Department of Physics, Louisiana State University, Baton Rouge, LA, USA, E-mail: mehaboobi.k@yahoo.edu*

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