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Morphology and Structure of Nb Thin Films Grown by Pulsed Laser Deposition at Different Substrate Temperatures

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This paper reports the fabrication of Nb thin films through pulsed laser deposition at different substrate temperatures, ranging from 300 to 660 K. While the variation of the substrate temperature does not affect significantly the excellent Nb thin film adhesion to the Si(100) substrate surface, the increase of the substrate temperature up to 570 K promotes an improvement of the grown film in terms of morphology and roughness. Such improvement is achieved through the formation of wider columnar structures with a reduced superficial roughness, around 5 nm, as shown by scanning electron microscopy (SEM) and atomic force microscopy. The use of temperatures over 570 K increases the substrates roughness due to the formation of irregular structures inside the film, as observed by SEM cross section analysis, and does not produce a relevant improvement on the crystalline structure of the material.

Key words: Pulsed laser deposition, Niobium, Superconducting radiofrequency cavities, Deposition temperature

1. Introduction

The use of superconducting materials for the acceleration of electrons, employing electromagnetic field in the region of radiofrequency, has received considerable attention in the recent years, for diverse applications and scientific schemes, such as in medicine and nuclear physics. Superconducting radiofrequency (srf) cavities play an important role in applications where near continuous wave operation and low dissipation powers are required. In this context, Nb has been widely investigated with regard to its potential use as srf cavities material in electron accelerator technology[1–5]. The use of Nb thin films, instead of the bulk material, was first proposed by Bemporad et al. in 2008[6] with the aim to reduce the material fabrication cost. Additionally, the