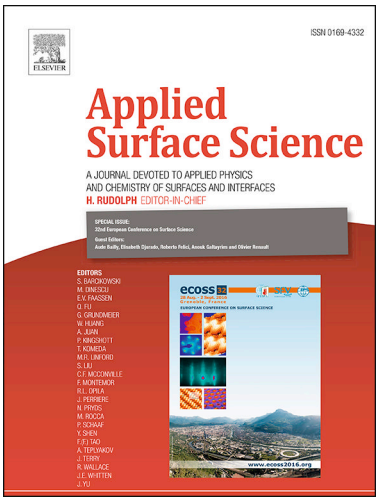

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Degradation of ultra-thin boron films in air

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Abstract

Corrosion of B films in air can limit their practical applications. Here, we study the evolution of the elemental composition, thickness, and morphology of $10 - 100$-nm-thick amorphous B films sputter-deposited onto glassy carbon substrates and stored under different conditions. Results show that films with thicknesses $\gtrsim 55$ nm have expected excellent corrosion resistance during storage in laboratory air at room temperature over several months. In contrast, $\lesssim 45$-nm-thick films exhibit pronounced degradation upon air exposure, starting with a change in the composition to ~ 30 and ~ 50 at.% of O and H, respectively. After such an O and H uptake, the degradation proceeds via mass loss with a characteristic time constant of ~ 5 days in air at room temperature. A post-deposition annealing at 1000 °C in an inert atmosphere makes all the films corrosion resistant.

Keywords: Boron, Oxidation, Thin films, Rutherford backscattering spectroscopy, AFM

1. Introduction

Thin films of elemental B are attractive for several applications, including ultraviolet and x-ray optics, [1, 2] neutron detectors, [3] biomedical coatings, [4] electronic devices, [5, 6] and protective layers in thermonuclear fusion reactors. [7] Boron films are also a starting point in a common method [8] of the

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