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Improvements on the local order of amorphous hydrogenated silicon carbide films

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Abstract

This paper reports improvements on the chemical and structural order of amorphous hydrogenated silicon carbide thin films, deposited by plasma enhanced chemical vapor deposition (PEVCD) at the 'starving plasma regime', from a gaseous mixture of silane, methane and hydrogen. Two deposition parameters: (i) the radio frequency (rf) power and (ii) the hydrogen dilution of the gaseous mixture were analyzed. The samples were characterized by Rutherford back-scattering (RBS) to obtain the film's composition, by Fourier transform infrared spectrometry (FTIR) to analyze the chemical bonds in the solid phase and by means of X-ray absorption spectroscopies (XAS) to determine the short range order around the silicon atoms. The results pointed towards the use of higher rf power (>50 W) and a gaseous mixture highly diluted in H₂ (a maximum H₂ flow of 400 standard cubic centimeter per minute (sccm) was used) as a route to achieve films with suitable properties. The best results are accomplished in films with a carbon content close to 50%. © 2001 Elsevier Science B.V. All rights reserved.

1. Introduction

The deposition of amorphous hydrogenated silicon carbide thin films, a-Si_{1-x}C_xH, by plasma enhanced chemical vapor deposition (PECVD) has been extensively studied due to the ability of this technique to control the carbon content, *x* (defined as the ratio between the number of C atoms and the total number of C plus Si atoms), in the solid phase and, therefore, the optical gap (*E_g*). The

increase in the optical gap, following the increase in the carbon concentration, is desirable for many device strategies [1,2]. The growth of a-Si_{1-x}C_xH thin films with very low conductivity (<10⁻¹⁴ Ω⁻¹ cm⁻¹) and high optical gap (higher than 3 eV) is particularly important for thin film transistor (TFT) technology based on amorphous materials [1–3]. The advantageous electrical, optical and chemical properties of these films are achieved at the so-called 'silane starving plasma' [4] regime. The experimental parameters that have to be controlled at this particular deposition condition have been already determined [5]. This regime is accountable for the growth of a-Si_{1-x}C_xH carbon rich alloys (carbon content up to 0.7), with 'dia-

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