

Mass spectrometric studies of the mechanism of film inhibition in hydrogen/methane plasmas in the presence of nitrogen

Abstract: Complete suppression of amorphous C:H film deposition has been reported for N-2/CH₄ ratios similar to 1, in low-pressure technical plasmas. This finding has been recently used by the authors for the proposal of a possible technique for the inhibition of re-deposited T-containing carbon films at the divertor region of fusion devices. Although several works aiming to the understanding of the underlying physicochemical processes have been published, the complexity of the system is far from being properly described by the proposed models. In the present work, experiments in DC glow discharges at low pressure of H-2/CH₄/N-2 admixtures (90:0-5:0-5) are described. Mass spectrometry of neutral species as well as plasma mass spectrometry for ion detection have been used as the main diagnostics. Several plasma conditions (plasma current, gas composition, etc.) as well as isotopic exchange (H/D) have been investigated. Also, the effect of progressive film growing on the metal walls of the reactor in the composition of gas-phase species has been investigated. It is concluded that wall carbonisation is required to trigger the inhibition process. Ethylene and acetylene are found as the main reaction products. (C) 2004 Elsevier Ltd. All rights reserved.