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Thin Solid Films 379 (2000) 1–6

thin solid films

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Raman scattering study of photoluminescent spark-processed porous InP

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Received 30 June 1999; received in revised form 25 July 2000; accepted 31 August 2000

Abstract

Raman scattering has been used to study porous InP (001) samples prepared by the application of high voltage spark discharges in air and argon atmospheres. For photoluminescent material, Raman scattering as well as Normaski microscopy of a transversally cut sample, (011) face, show the existence of two very distinct zones, that lie at different depths: a superficial luminescent region constituted mostly by In_2O_3 and $InPO_4$ oxides, and a second adjacent deeper zone formed by damaged InP. These results highlight the role that the oxidation plays in this material as source of the visible luminescence that the material emits when excited with UV radiation. The deepest region shows InP-like vibrational behavior with broad longitudinal optical (LO) and transversal optical (TO) phonon bands. A fit of the observed lineshapes of the TO and LO modes using the spatial correlation model provides an estimate of the size of the crystalline regions ($L \sim 30$ Å).

PACS: 78.66.Fd

Keywords: Raman scattering; Indium phosphide; Oxidation; Semiconductors

1. Introduction

In recent years porous materials have attracted considerable interest due to the discovery that porous Si (p-Si) photoluminesces [1] in the visible and by the fact that this phenomenon may be produced by confined electrons in nanometric sized granules or pillars in the p-Si [2]. Spark-processing is a useful alternative to prepare new photoluminescent semiconductor porous materials [3]. Recently, there has been a report on the light emission properties of porous InP prepared by this method [4]. The spark-processed porous InP (spp-InP) emits light in three different bands: a red, a yellow–green and a blue–violet band, centered at 1.85, 2.4 and 3.1 eV [4]. In the same work, the photoluminescence (PL) is attributed to possible confinement effects of carriers in the nanometric granules produced during the sparking, but with at least the band in the yellow–green region (centered at ~ 2.4 eV) having possible contributions to the luminescence from P oxides.

In this work we present the results of a study of the vibrational properties of spp-InP at room temperature. This technique provides important information on the existence of several different oxides and their relative location as well as their essential role in the PL that spp-InP emits.

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0040-6090/00/$ - see front matter
PII: S0040-6090(00)01565-0