INSTITUTE OF PHYSICS PUBLISHING JOURNAL OF PHYSICS: CONDENSED MATTER

J. Phys.: Condens. Matter **13** (2001) 6687–6706 PII: S0953-8984(01)22602-2

# Fröhlich modes in porous III–V semiconductors

**A Sarua[1], J Monecke[1], G Irmer[1], I M Tiginyanu[2,3], G Gärtner[4] and H L Hartnagel[5]**

[1] Institut für Theoretische Physik, TU Bergakademie Freiberg, Bernhard-von-Cotta-Strasse 4, D-09596 Freiberg, Germany
[2] Department of Electrical Engineering and Computer Science, The University of Michigan, 1301 Beal Avenue, Ann Arbor, MI 48109-2122, USA
[3] Institute of Applied Physics, Technical University of Moldova, Boulevard Stefan cel Mare 168, MD-2004 Chisinau, Moldova
[4] Institut für Experimentelle Physik, TU Bergakademie Freiberg, Silbermannstrasse 1, D-09596 Freiberg, Germany
[5] Institut für Hochfrequenztechnik, TU Darmstadt, Merckstrasse 25, D-64283 Darmstadt, Germany

E-mail: sarua@physik.tu-freiberg.de

Received 7 March 2001, in final form 15 May 2001
Published 19 July 2001
Online at stacks.iop.org/JPhysCM/13/6687

**Abstract**

Porous GaP, InP and GaAs structures fabricated by MeV ion-implantation-assisted electrochemical etching were investigated by Raman and Fourier transform infrared spectroscopy. Fröhlich modes in the frequency gap between the transverse optical and longitudinal optical frequencies were observed and their longitudinal–transverse splitting was established. The frequency-dependent optical properties in the infrared region were calculated using a dielectric function derived on the basis of an appropriate two-dimensional effective-medium theory. The theoretical reflectance spectra are found to be in good agreement with the experimental ones and the predicted coupled Fröhlich–plasmon modes for conducting samples were observed experimentally. The wavelength used in Raman measurements did not fulfil the requirements of effective-medium theory, but the resulting spectra could be explained at least qualitatively by taking into account the diffuse scattering.

## 1. Introduction

Increasing attention has been paid in recent years to the study of the properties inherent to porous materials. In addition to porous silicon, widely investigated by a variety of different means [1, 2], porous III–V semiconductor compounds have aroused increasing interest [3–9] due to their potential applications in the field of electronics and photonics [10].

  