



ELSEVIER

Physica B 249–251 (1998) 731–734

PHYSICA B

## Subband structure and anomalous valley splitting in ultra-thin silicon-on-insulator MOSFET's

T. Ouisse<sup>a,\*</sup>, D.K. Maude<sup>b</sup>, S. Horiguchi<sup>c</sup>, Y. Ono<sup>c</sup>, Y. Takahashi<sup>c</sup>,  
K. Murase<sup>c</sup>, S. Cristoloveanu<sup>a</sup>

<sup>a</sup> *Laboratoire de Physique des composants à Semiconducteurs (LPCS), UMR-CNRS 5531, ENSERG, 23, rue des martyrs, 38016, Grenoble, France*

<sup>b</sup> *Grenoble High Magnetic Field Laboratory (LCMI), MPI-CNRS, 38042, Grenoble, France*

<sup>c</sup> *NTT Basic Research Laboratories, 3-1 Morinosato Wakamiya, Atsugi-Shi, Kanagawa Pref., 243-01, Japan*

### Abstract

Shubnikov–de Haas oscillations have been investigated in Silicon-on-insulator MOSFET's with silicon film thicknesses down to 3 nm. The lifting of the valley degeneracy may reach 20 meV. This anomalous valley splitting is tentatively attributed to a combination of a higher quantum confinement and a rough back interface. © 1998 Elsevier Science B.V. All rights reserved.

*Keywords:* Silicon-on-insulator; Valley splitting; MOSFET

### 1. Introduction

Due to the process versatility provided by the use of SiO<sub>2</sub>, the silicon MOS technology is a good candidate for building low-dimensional structures. Silicon-on-insulator (SOI) technology offers the opportunity to restrict “automatically” the vertical dimension. Low dimensional SOI structures have already been produced, such as ultra-thin SOI MOSFET's with Si film thicknesses down to 2 nm [1], SOI quantum wires and single-electron devices [2]. In this paper we focus on the electronic properties of two-dimensional SOI MOSFET's with Si

film thicknesses  $t_{\text{Si}}$  ranging from 3 to 6 nm (Fig. 1). These properties have been investigated by means of the Shubnikov–de Haas (SdH) oscillations of the conductivity. The aim of this paper is to show that the combination of a higher electron confinement and a difference in quality between the front and back interfaces provides the ability to observe physical effects which usually do not appear in conventional bulk Si MOSFET's, or are observed to a much lesser extent. In particular, we report a lifting of the valley degeneracy  $g_v$  which may be as high as 20 meV, whereas conventional Si MOSFET's usually exhibit a splitting lower than 1 meV [3–6]. This phenomenon results in the observation of multi-subband transport, leading to very clear beating effects in the SdH conductance curves vs magnetic field.

\* Corresponding author. Tel.: + 33 476 85 60 50; fax: 33 476 85 60 70; e-mail: ouisse@enserg.fr.