
Heat diffusion in the two-layer system GaAs/GaSb joined by the fusion technique

Antonio Calderón, Rocío A Muñoz Hernández

CICATA-IPN, Legaria 694 Col. Irrigación, 115000 México City, Mexico

José F Sánchez Ramírez, José L Herrera Pérez

Instituto de Física, BUAP, Apdo. Postal J-48, Puebla, Pue., 72570, Mexico

Alfredo Cruz Orea, Feliciano Sánchez Sinencio

Depto. de Física, CINVESTAV-IPN, Apdo. Postal 14-740, 07000 México City, Mexico;

fax: +52 5 747 7096; email: orea@fis.cinvestav.mx

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Abstract. Heat diffusion is studied in the two-layer GaAs/GaSb system, produced by the union of wafers by means of the fusion technique. Analysis of the thermal diffusivity of these systems demonstrates the role that the union plays in heat transport in these systems as a function of the temperature used in the joining process. The thermal diffusivity measurements were carried out by means of the photoacoustic technique in a heat transmission configuration.

1 Introduction

It is well known that the thermal diffusivity is a physical parameter extremely sensitive to the composition, structure, and processing conditions of materials (Rosencwaig 1980). The case of multilayer materials is of special importance because they appear frequently in nature as well as in artificial materials.

The open photoacoustic cell (OPC) technique is a photoacoustic (PA) technique, in a heat transmission configuration, which uses an electret microphone as transducer and detector, simultaneously. The OPC technique has been applied to thermal characterisation of a wide variety of solids and liquids since its presentation (Perondi and Miranda 1987; Leite and Miranda 1992). One of the thermal parameters most frequently measured by this technique is the thermal diffusivity. The typical thickness of the samples measured in this technique ranges from tens to some hundreds of micrometres (Calderón et al 1998).

In electronic devices is very common to find that multilayer semiconductor systems and different techniques have been developed to make these systems. Recently, in order to join different semiconductor materials, a technique called fusion of wafers has been developed (Liau and Mull 1990), which is a special case of a direct union where strong chemical bonds are created in the interface of these materials. To obtain this union, materials free of oxides are placed in direct contact and they are heated to high temperatures while uniaxial pressure is applied during a period of time in a hydrogenate atmosphere. While the study of the electric properties in these systems has received increasing interest (Kish 1995), the thermal properties are a topic little studied up to now.

In this work we present a study of heat diffusion in two-layer GaAs/GaSb systems, produced by means of the previously described procedure, and it is shown that the analysis of the thermal diffusivity of these systems gives information on the important role that the interface plays in heat transport in these systems as a function of the temperature used in the union process.