# THEORETICAL AND EXPERIMENTAL PICOSECOND ULTRASONICS INVESTIGATIONS OF MULTILAYERED SYSTEMS

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Picosecond ultrasonics appeared to be a powerful tool for the study of multilayered structures[1-5]. In such a technique the absorption of a short laser pulse generates fast acoustic transient phenomena which produce both stationary waves trapped within a small number of layers and progressive waves propagating through the whole structure. These fields are probed by recording the amplitude and the phase changes[6] of the electromagnetic field of a time-delayed laser pulse reflected by the multilayered structure.

The problem of acoustic field generation and detection in such structures is complex since as far as pump or probe light propagates, each layer acts as an individual acoustic emitter (and receiver). We will present general results and compact expressions for the time dependence of the relative change of the optical reflectivity of a multilayered structure insonified by a short pump laser pulse. These results, obtained by a transfer matrix approach, work for any multilayered system:

- For a finite number of layers our approach leads to a fast algorithm that allows the analysis of picosecond ultrasonics experiments and can be used for nondestructive evaluation of multilayers in microelectronics.
- For a semi-infinite periodic structure, analytical expressions can be obtained for the respective amplitudes of the progressive waves, the folded modes and the so-called localized modes and their dependence in terms of the multilayer period.

Experimental results obtained on various opaque metallic multilayers and semi-transparent semiconductor superlattices will be presented.

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