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Optical characterization of the acoustic response in a nanostructure using the transient reflection matrix formalism

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The transient reflectometry and transient interferometry are the most commonly used techniques of picosecond acoustics for the study of isotropic planar stratified nanostructures. Nevertheless when anisotropy is present in the sample, the standard techniques have to be completed by transient polarimetry. The reflection properties of an anisotropic sample at oblique incidence are completely determined by the 2x2 reflection matrix (RM): R=[rpp,rps;rsp,rss]. Considering that the transient acoustic phenomena induce a perturbation ΔR of the reflection matrix, we demonstrate that the transient reflection matrix (TRM): $\Delta R \cdot R^{-1}$, where R^{-1} is the inverse of the reflection matrix, can be completely determined experimentally using the three techniques: transient reflectometry, interferometry and polarimetry (TRIP). In particular, the off-diagonal components of the TRM can be determined by transient polarimetry measurements only. Moreover, theoretical calculations of the TRM point up the close relation between the off-diagonal components of the TRM and the presence of a shear strain wave propagating perpendicularly to the free surface of the sample. Experimental results using the transient polarimetry technique will be presented to support the theoretical prediction of the TRM formalism.