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Picosecond ultrasonics in inhomogeneous gold media

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An all optical laser ultrasonic technique is used to generate and detect picosecond coherent acoustic modes in a gold film medium revealed by X-ray texture analysis to be of a bulk inhomogeneous structure. The inhomogeneity of the films arises from utilizing DC sputtering, in contrast with the RF sputtering technique of deposition that results in perfectly structured films of epitaxial character. As a consequence of the gold crystallites' inhomogeneous orientation, the pump-probe picosecond transient reflectivity response highlights an uncommon slow ringing mode attributed to the excitation of the fundamental shear mode. The shear nature of this uncommon ringing mode is confirmed by both the X-ray texture technique, that relies upon a shear velocity coincident with the ultrafast experimental data, and by the strong difference in the photoelastic behavior of the longitudinal and the shear modes. We also demonstrate that the imperfect adhesion at the boundary strongly affects the shear mode behavior whose acoustic dispersion is linked to the adhesion.

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