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Picosecond laser ultrasonic measurements of surface waves on patterned layered nanostructures[1] SAM GARTENSTEIN, MOLLY JAMES, SUSHANT MAHAT, ERIK SZWED, BRIAN DALY, Vassar College, WEILI CUI, SUNY Maritime College, GEORGE ANTONELLI, Antonelli Research and Technology — We report ultrafast optical pump-probe measurements of 5 – 25 GHz surface acoustic waves (SAWs) on patterned layered nanostructures. These very high frequency SAWs were generated and detected on the following patterned film stack: 25 nm physically vapor deposited Al / 60-110 nm thermally grown a-SiO_2 / Si (100) substrate. The Al was etched to form lines of rectangular cross section with pitches ranging from 1000 nm down to 140 nm and the lines were oriented parallel to the [110] direction on the wafer surface. The absorption of ultrafast pulses from a Ti:sapphire oscillator operating at 800 nm generated SAWs that were detected by time-delayed probe pulses from the same oscillator via a reflectivity change (ΔR). The SAW frequency increased with decreasing pitch in a non-linear fashion due to dispersion of the wave caused by the presence of the oxide layer. We also experimentally demonstrate the traveling of the SAW's by separating the focused pump and probe laser spots by several microns. We compare the results to coarse-grained molecular dynamics simulations and simplified calculations using isotropic elasticity theory.

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