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Ultrafast optical measurements of surface waves on a patterned layered nanostructure[1] BRIAN DALY, MATTEO BJORNSSON, AINE CONNOLLY, SUSHANT MAHAT, BRYAN RACHMILOWITZ, Vassar College, GEORGE ANTONELLI, Antonelli Research & Technology LLC, ALAN MYERS, HUI-JAE YOO, KANWAL SINGH, SEAN KING, Intel Corporation — We report ultrafast optical pump-probe measurements of 12 – 54 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 TiN / 180 nm porous PECVD-grown a-SiOC:H dielectric / 12 nm non-porous PECVD-grown a-SiOC:H etch-stop / 100 nm CVD-grown a-SiO_2 / Si (100) substrate. The TiN layer was dry plasma etched to form lines of rectangular cross section with pitches of 420 nm, 250 nm, 180 nm, and 168 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). In each of the four cases the SAW frequency increased with decreasing pitch, but not in a linear way as had been seen in previous experiments of this sort. By comparing the results with mechanical simulations, we present evidence for the detection of different types of SAWs in each case, including Rayleigh-like waves, Sezawa waves, and leaky or radiative waves.

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