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Laser-generated surface acoustic waves in copper line arrays on silicon

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Laser-generated acoustics waves are widely used to control the fabrication on metal interconnect structures in the semiconductor industry. On the other hand, acoustic properties of such structures, typically comprised of periodic arrays of metal lines embedded in a dielectric film on a silicon substrate, pose some interesting wave propagation problems. We will report measurements of surface acoustic waves (SAWs) performed using laser-induced transient grating technique on periodic arrays of micron-wide copper lines. As expected, SAW dispersion curves yield small bandgaps at the Brillouin zone boundary. However, much larger bandgaps are observed within the 1st Brillouin zone. We believe that these giant bandgaps are formed due to avoided crossing of the 1st and 2nd order surface acoustic modes of the film/substrate structure when the 1st mode dispersion curve becomes folded due to periodicity. Another observed phenomenon is a spectacularly sharp increase in the acoustic attenuation occurring when the folded surface mode becomes coupled to a bulk wave.