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THz Optical Response from Coupled Ferroelectric/LO Phonon Mode in BaTiO3/Si(100) MUNEAKI HASE, MASAHIRO KITAJIMA, Mat Engr Lab, Natl Inst for Mat Sci, Ibaraki 305-0047 Japan, VENU VAITHYANATHAN, DARRELL G. SCHLOM, Dept of Mat Sci and Engr, Penn State Univ, JEREMY LEVY, HRVOJE PETEK, Dept of Physics, Univ of Pittsburgh — The large second-order polarizabilities of epitaxially grown ferroelectrics can be used to generate THz-bandwidth electric fields in semiconductors. Epitaxial films of $BaTiO_3$have been grown on Si(100) using oxide-MBE. X-ray diffraction measurements indicate a high degree of structural perfection and an out-of-plane polarization direction. The coupling between $BaTiO_3$ and Si is investigated using an optical pump-probe transient reflectivity experiment that uses 10 fs pulses of light centered around λ=400 nm. The pump pulse excites the LO phonon mode of the Si substrate directly (15.5 THz) as well as the lower frequency soft modes (1-4 THz) of the ferroelectric film. The observed Fano lineshape, obtained by Fourier transforming the time-domain data, suggests a strong coupling between the LO phonon and ferroelectric modes. The photon energy dependence of the observed electro-optic response suggests that the electro-optic response is generated by the LO phonon and is mixed strongly with the ferroelectric response. The high bandwidth coupling of optical and electronic degrees of freedom is promising for silicon-based quantum computing applications. This work was supported by the NSF, MEXT, NIMS, and DARPA QuIST.

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