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Electronic Raman Scattering as an Ultra-Sensitive Probe of Strain Effects in Semiconductors.[1] ANGELO MASCARENHAS, BRIAN FLUEGEL, DAN BEATON, National Renewable Energy Laboratory — Semiconductor strain engineering has become a critical feature of high-performance electronics due to the significant device performance enhancements it enables. These improvements that emerge from strain induced modifications to the electronic band structure necessitate new ultra-sensitive tools for probing strain in semiconductors. Using electronic Raman scattering, we recently showed that it is possible to measure minute amounts of strain in thin semiconductor epilayers. We applied this strain measurement technique to two different semiconductor alloy systems, using coherently strained epitaxial thin films specifically designed to produce lattice-mismatch strains as small as 10^{-4}. Comparing our strain sensitivity and signal strength in $Al_xGa_{1-x}As$ with those obtained using the industry-standard technique of phonon Raman scattering we found a sensitivity improvement of 200, and a signal enhancement of 4 10^3 thus obviating key constraints in semiconductor strain metrology. The sensitivity of this approach rivals that of contemporary techniques and opens up a new realm for optically probing strain effects on electronic band structure.

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