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Extremely nondegenerate two-photon absorption in semiconductors DAVID HAGAN, CREOL, University of Central Florida, CLAUDIU CIRLOGANU, Georgia Institute of Technology, SCOTT WEBSTER, DMITRY FISHMAN, ERIC VAN STRYLAND, CREOL, University of Central Florida — Degenerate two-photon absorption, 2PA, in direct-gap semiconductors has long been known to scale with the inverse third power of the band gap, resulting in very large 2PA coefficients for narrow-gap semiconductors. We show that for any given pair of photon energies, (sum $=\hbar\omega_1 + \hbar\omega_2$), the 2PA is smallest for the degenerate case, $\omega_1 = \omega_2$, and is enhanced by orders of magnitude in the extremely nondegenerate case *($\omega_1/\omega_2 >> 1$ or $\omega_1/\omega_2 << 1$)*. We experimentally demonstrate that 2PA in direct-gap semiconductors (e.g. GaAs, CdTe, ZnSe, ZnO, GaN) is enhanced over the degenerate value by up to 3 orders of magnitude using extremely nondegenerate pairs of photons (energy ratios $\sim$10/1). These extremely nondegenerate 2PA coefficients are similar in magnitude to coefficients obtained in narrow-gap semiconductors such as InSb and make 2PA feasible for applications such as subfemtosecond gated detection, all-optical switching etc. We demonstrate gated detection in a GaN LED used in a reverse-biased detection mode with fs 5.6μm and 400nm pulses. We see nearly 4 orders of magnitude enhancement over the degenerate case and can also easily detect sub-nW of IR light using modulation methods.

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