Resonant absorption of a short-pulse laser in a doped dielectric

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A simple model is used to calculate the efficiency of energy absorption when a laser of short pulselength impinges on a dielectric slab that is doped with an impurity with a resonant line at the laser frequency. The impurity is assumed to have a finite linewidth. Dimensionless parameters are constructed that combine the dopant concentration, the dopant resonant linewidth, laser pulselength, separation between the laser frequency and the dopant transition frequency, and the width of the dielectric slab. This allows calculation with one set of normalized parameters be used to infer the results expected for other sets of parameters. It is found that the energy absorption efficiency is maximized for a certain degree of doping concentration (at a given pulselength), and also for a certain pulselength (at a given dopant concentration). Typically, tens of percent of the laser energy can be resonantly absorbed with only a modest amount of impurities.

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