High-quality seed pulses from mirror-dispersion-controlled Ti:sapphire system allow chirped pulse amplification without a pulse stretcher.

Chirped dielectric mirrors improve Ti:sapphire lasers

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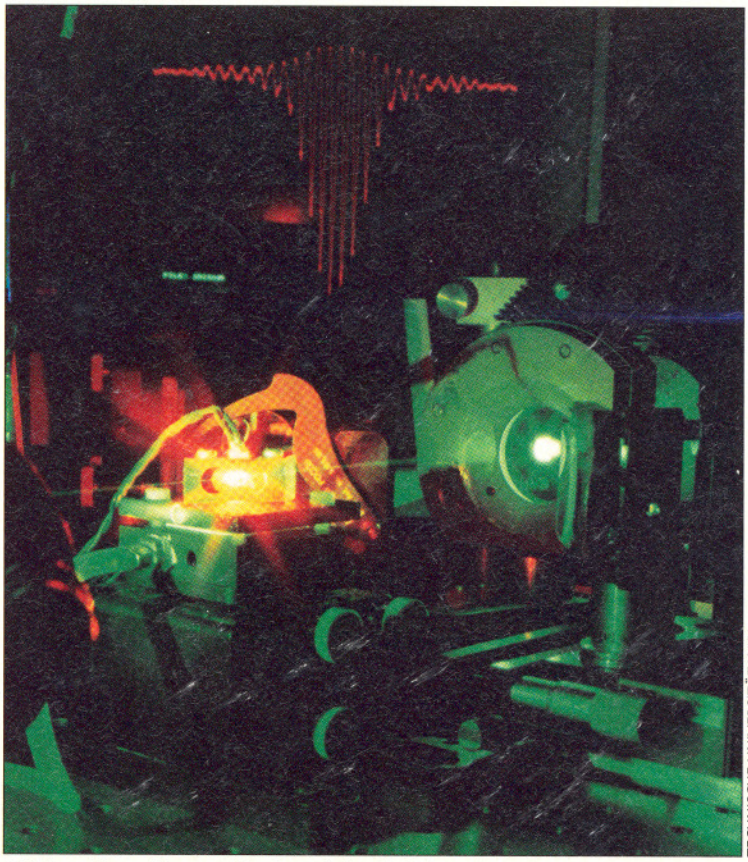

Multipass Ti:sapphire amplifier is seeded with high-quality 8-fs pulses generated by a Ti:sapphire oscillator incorporating chirped dielectric mirrors for dispersion compensation.

Titanium-doped sapphire (Ti:sapphire) is probably the most successful laser medium used in ultrafast lasers because of its broad gain bandwidth (approximately 200 nm FWHM) and excellent mechanical and thermal properties. The discovery of self- or Kerr-lens modelocking has also opened the way to an efficient exploitation of its enormous optical bandwidth for ultrashort pulse generation.[1,2]

Commercial self-modelocked Ti:sapphire lasers, offering average output powers up to 2 W and pulse durations as low as 50 fs, are now commonplace in ultrafast laboratories. The Ti:sapphire medium is also well suited for extracavity amplification, yielding high-power femtosecond pulses. Several manufacturers offer Ti:sapphire oscillator-amplifier systems that can produce pulses in the 100-fs range with terawatt peak powers and repetition rates of 10 Hz or less. Whereas these femtosecond commercial systems represent dramatic progress in terms of reliability, lifetime, and peak power, the pulse duration they offer is not significantly shorter than that available from the previous-generation, dye-laser-based systems. Nevertheless, the broad bandwidth of Ti:sapphire and the ultrafast response of the Kerr effect potentially allow the generation of substantially shorter pulses.

The motivation for further decreasing pulse durations comes from a number of fields. Researchers often need to achieve high powers without producing excessive pulse energies that cause damage to solid targets. In reversible optical experiments, metals, semiconductors, and insulators can be exposed to femtosecond pulses with intensities orders-of-magnitude higher than practicable with picosecond pulses. In moderate-intensity spectroscopy, pulse duration determines the achievable time resolution of pump-probe experiments.

Sub-100-fs time resolution, available since the early 1980s, is usually sufficient to "freeze" the rotational and vibrational dynamics of complex atomic systems such as molecules, clusters, and condensed matter, and even the motion of sufficiently heavy atoms in chemical processes. Microscopic dynamics, however, often take place on a time scale of roughly 10 fs or less. For instance, the study of coherent light-matter interaction, which provides information about the coupling of atoms, ions, and molecules to their surroundings, calls for sub-10-fs

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