Long-pulse coherent waveforms from a fiber laser

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Abstract

Passively modelocked long-pulse lasers were made using fiber gratings, MQW nonlinear reflectors and active fiber media. Singlemode Nd- and Er-doped fibers and cladding-pumped fiber lasers operated in high-stability and multi-pulsing regimes.

Summary

We have found that the combination of fiber laser media with gratings and passive mode-locking reflectors yields an excellent source of long-pulse(0.5-2 ns), relatively low PRF ($<$50MHz), coherent waveforms.

The fiber gratings served to couple the light out, select the wavelength, and narrow the lasing spectrum. Our goal was to obtain a coherent lasing bandwidth of between 0.5 and 2 GHz.

We have used gratings ranging from 1 cm to 6 cm in length, with low ($<10\%$) and moderate (30-70%) reflectivies, some fabricated by holographic exposure and others through a phase mask. We also report the first demonstration of grating exposure in Nd:Ge:cladding-pumped fibers.

The passive mode-locking reflectors were MQW anti-resonant Fabry-Perot saturable absorbers (A-FPSA) which used the Fresnel surface reflection of the MQW material as the outer reflector. In low power experiments ($\sim$1-3mW, at both 1.06um and 1.55um), the fiber was held in a polished glass capillary and the A-FPSA was spring loaded against the end. Pump power determined whether the laser operated with single or multiple pulses in one round trip. In higher power experiments using cladding-pumped fiber (with output power up to 380 mW, average), the A-FPSA was pulled back slightly from the fiber end to control the incident intensity. Modelocking was self-starting in either case.

Stability was measured by both homodyne and heterodyne techniques. The heterodyne measurements were made by mixing the output of a passively modelocked fiber laser with a single mode Nd:YAG laser. The grating output coupler of the fiber laser was PZT-compressed to tune the Nd-doped silica fiber laser output to 1.064um. Over a 25us digital sample, the laser coherence was such as to give Fourier-transform-limited spectral components.

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