DYNAMIC GRATINGS INDUCED BY MODE INSTABILITIES IN FIBER LASERS

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Fiber lasers and amplifiers belong inherently to key inventions of modern physics and optics. Progress of their output power and efficiency (leading to energy savings) is one of the hot topics of today's global research. Fiber lasers passed through spectacular advance from telecommunications to high-power. Despite a great research effort has already been exerted, a number of research topics are still unresolved and new issues emerge. This is the case of various kinds of instabilities of fiber laser devices including transverse modal instability in large-mode area fibers. Other types of instabilities are modes of self-pulsations that may have catastrophic consequences. For example, improperly designed rare-earth doped fiber high-power amplifier chain may in some conditions generate intense pulses that may destroy inline components as well as the pump lasers. Such self-pulsation often evolves from longitudinal-mode instabilities in fiber lasers.
We report on recent results of investigation of a special mode of the self-pulsing, longitudinal-mode-instability regime, the so-called self-induced laser line sweeping (SLLS). This description reflects the fact that the self-pulsing (in the form of self-sustained relaxation oscillations) coexists with spectacular laser line drift with time. It is accompanied by creation of dynamic refractive index grating along the active fiber in the laser cavity [1]. Such gratings have pitch of less than a micrometer, defined by half of the wavelength of the laser mode responsible for the grating build-up. Although longitudinal mode instabilities in fiber lasers are known for a long time, the associated refractive index gratings were studied only recently. New findings in evaluation of reflectivity of such dynamic gratings in self-swept ytterbium fiber laser will be presented. Review of research of the SLLS effect in fiber lasers will be also given as well as comparison of the transverse- and longitudinal-mode instabilities in fiber laser devices.

[1] P. Peterka, P. Koška and J. Čtyroký, "Reflectivity of superimposed Bragg gratings induced by longitudinal mode instabilities in fiber lasers," *IEEE J. Sel. Top. Quantum Electron.* **24**, 0902608 (2018).