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Recent Advances in Development of Mode-Locked Fiber Lasers: Special Cavity Topologies and Novel Fiber-Optics Elements

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Abstract

Our recent achievements in experimental development of passively mode-locked fiber laser systems are briefly reviewed. Special cavity topologies and novel fiber-optics elements were designed and studied in order to improve laser performance and usability.

A special laser cavity topology can combine advantages of different types of cavities and allow extended management of lasing. Thus, it opens up possibility for building mode-locked fiber lasers with improved performance and tuning capability [1, 2]. For instance, nontrivial cavity topologies allowed us to build mode-locked fiber lasers with high (μJ-level) per-pulse energy. Also an original "drop-shaped" cavity design (based on a modified ring topology) was proposed and implemented in a femtosecond mode-locked fiber laser. This design allowed us to reduce number of the laser cavity elements as compared with conventional sigma-shaped cavities, but similarly to them it allowed tuning of the cavity length and polarization.

Besides, novel fiber-optics elements intended for all-fiber mode-locked fiber lasers were proposed and preliminary studied. Thus, a fiber-coupled polymer-free carbon nanotube (CNT) film was used to achieve mode-locking in an all-fiber laser [3]. Application of polymer-free CNT films solves problems related to degradation of conventional polymer matrices of CNT-based saturable absorbers and paves the way to reliable and long-lasting mode-lockers for all-fiber lasers. Also fiber-to-fiber nonlinear coupling via a nematic liquid crystal (NLC) was studied experimentally [4]. This study demonstrated feasibility of in-line NLC-based fiber-optic elements with various functionalities such as laser frequency conversion, power limitation, polarization control. The latter was considered for implementation of an electro-optical retarder (a variable phase plate) which can be used in all-fiber lasers mode-locked via nonlinear polarization evolution.

References

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