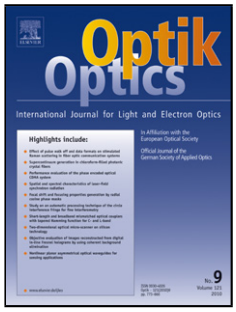


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# Novel output states in the erbium-doped fiber laser near zero dispersion with semiconductor saturable absorber mirror

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**Abstract:** we report the observation of operation states near zero dispersion in the erbium-doped fiber laser with semiconductor saturable absorber mirror（SESAM）. The Q-switching, Q-switching mode-locking（QML）, continuous wave mode-locking (CML), harmonic mode-locking(HML), double-pulse and multiple-pulse operation states can be manipulated by adjusting the polarization controller with semiconductor saturable absorber mirror. The output 3dB spectral bandwidth and pulse width of operation states are also measured and analyzed. It is shown that continuous wave mode-locked state is stable and without spectral sidebands. Therefore, the proposed scheme will be useful and feasible in the optical telecommunication system.

**Key words:** erbium-doped fiber laser (EDFL), mode locking, semiconductor saturable absorber mirror (SESAM).

## 1. Introduction

The ultra-short optical pulse has attracted much attention because of their potential applications in communications and signal processing[1-3]. However, the self-started, passively mode-locked fiber laser is a simple and economic ultra-short pulse source. Since 1990s, passively mode-locked fiber laser at 1550nm wavelength has made great progress due to the breakthrough of Erbium-doped fiber. Several techniques including nonlinear polarization rotation[4], stretched pulse[5], additive pulse mode-locking[6], figure-8 fiber laser which utilizes the nonlinear amplifying loop mirror technique[7-8] and the dispersion-imbalanced nonlinear amplifying loop mirror technique[9] have been used to generate the ultra-short optical pulse. However, the SESAM technology has many advantages compared to the above methods, for examples, mode-locking by exploiting nonlinear polarization evolution. It offers a self-started pulse operation and good environmental stability. Therefore, SESAM technology has been widely used to generate mode-locking pulse in different solid-state and fiber lasers [10-14]. Generally, mode-locked Erbium-doped fiber lasers operate in the net negative cavity dispersion regime, where the fiber nonlinear optical Kerr effect balances the dispersion of the