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Theoretical investigation of two-wave mixing in a broad-area semiconductor amplifier with moving gratings

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Abstract: The two-wave mixing in a broad-area semiconductor amplifier with moving gratings is investigated theoretically, where a pump beam and a signal beam with different frequencies are considered, thus both a moving phase grating and a moving gain grating are induced in the amplifier. The coupled-wave equations of two-wave mixing are derived based on the Maxwell's wave equation and rate equation of the carrier density. The analytical solutions of the coupled-wave equations are obtained in the condition of small signal when the total intensity is far below the saturation intensity of the amplifier. The results show that the optical gain of the amplifier is affected by both the moving phase grating and the moving gain grating, and there is energy exchange between the pump and signal beams. Depending on the moving direction of the gratings and the anti-guiding parameter, the optical gain may increase or decrease due to the two-wave mixing.

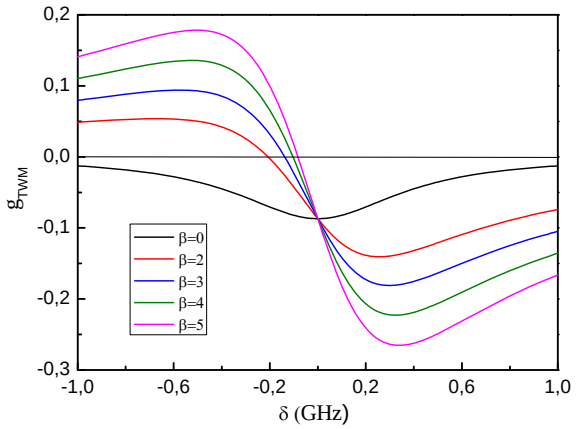

Fig. 1. The two-wave mixing gain g_{TWM} versus frequency difference between signal and pump δ with different anti-guiding parameter β.