

Novel Optoelectronics Circuits Employing Resonant Tunnelling Diodes

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Abstract

Nanostructures based on double barrier quantum well (DBQW) resonant tunnelling diodes (RTDs) have been intensively investigated due to wide bandwidth negative differential conductance (NDC) [1]. Recently, our group showed optoelectronic applications of DBQW-RTDs implemented successively in the AlGaAs/GaAs and the InGaAlAs/InP material systems as optical modulators and laser diode drivers [2,3]. When embedded in conventional electronic and optoelectronic devices and circuits [1-3] nanodevices such as DBQW-RTDs can increase devices functionalities leading to novel systems with high potential for applications in communications. In particular, the integration of a RTD with a LD can significantly reduce complexity of circuits needed for communications. Followed the demonstration of its potential as an optical intensity modulator [1] and application in a LD driver configuration [3], we have shown a RTD-LD can operate as a self-oscillating optoelectronic circuit that when externally perturbed is capable of frequency division, generation of chaotic electrical and optical carriers [4]. Fig. 1(a) present experimental laser output modulation induced by a low voltage AC signal at 1 GHz; Fig. 1(b) shows numerical demonstration of synchronization of two circuits behaving chaotically, where S represents laser photon density.

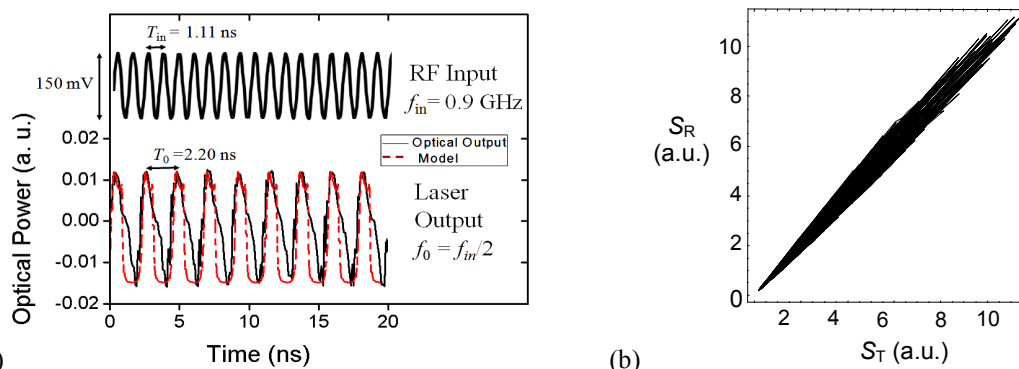


Fig. 1 (a) Laser output showing frequency division by 2 when a 150 mV sinusoidal voltage at 0.9 GHz is applied; the dash-line shows the model prediction; (b) Numerical results of optical synchronization of transmitter and receiver RTD-LD circuits; $S_{T,R}$ is the photon density of transmitter/receiver (T/R).

These are preliminary evidences of the potential applications of the DBQW-RTD in LD driver circuits for novel communication systems based on chaotic optical carriers [5].

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