# Quantum Dot VCSELs

V. M. Ustinov

*A. F. Ioffe Physico-Technical Institute*

*Politekhnicheskaya 26, 194021 St. Petersburg, Russia*

e-mail: vmust@beam.ioffe.rssi.ru

Quantum dot lasers attract currently attention due to the possibility to achieve record low threshold current density and to broaden the wavelength emission range for a certain heterostructure system. Vertical cavity surface emitting lasers (VCSELs) demonstrate several advantages important for device applications, i.e., superior beam quality, improved temperature stability, ultra-low threshold currents, cost-effective planar fabrication. In the present work we discuss the current status of quantum dot VCSELs designed for applications in fiber optical communication systems.

First, basic issues of synthesis of quantum dot heterostructures in the InAs/GaAs system are given. The possibility to achieve 1.3 micron emission wavelength is demonstrated.

Second, characteristics of both wide stripe and single mode edge emitting lasers are given. They show very low threshold current densities, high differential efficiency and high output power. Narrow stripe 1.3 micron quantum dot lasers demonstrate single mode operation, record low threshold current and CW output power in excess of 100 mW.

Third, we report on quantum dot VCSELs emitting at 1.3 micron. The aspects associated with the design of optical resonator and active region are discussed. Single mode room temperature CW output power as high as 2 mW and multi-mode CW output power as high as 3 mW are demonstrated. These results well correspond to the requirements for fiber optical applications.