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Two-State Polariton Lasing in a Planar Semiconductor Microcavity[1] FENG-KUO HSU, Department of Physics and Astronomy, Michigan State University, USA, YI-SHAN LEE, SHENG-DI LIN, Department of Electronics Engineering, National Chiao Tung University, Taiwan, CHIH-WEI LAI, Department of Physics and Astronomy, Michigan State University, USA — We report room-temperature sequential polariton lasing at two distinct energies in a planar microcavity non-resonantly pumped by a 2-ps pulsed laser. The sample consists of multiple InGaAs/GaAs quantum wells embedded within GaAs/AlGaAs distributed Bragg mirrors. A sub-10-ps high energy (HE) lasing mode with a linewidth $\sim$ 3 meV commences within 10 ps after pump, and is followed by a 20 to 50 ps low energy (LE) mode with a transient linewidth $\sim$ 1 meV. The time-average degree of polarization of both states decrease with increasing photoexcited densities. Near above the lasing threshold, the HE state is spin polarized, resulting in fully circularly polarized radiation under a circularly polarized pump and partially circularly polarized radiation under a linearly polarized pump. In contrast, the LE state is partially linearly polarized with stochastic polarization orientations that are weakly correlated to the [110] crystalline direction. The energy difference between the two lasing modes is controlled by the photoexcited density and pump polarization. With increasing pump flux, the HE state blue-shifts about 5 meV, while the LE state red-shifts less than 1 meV. This two-state lasing effect exemplifies spontaneous symmetry breaking in a microcavity laser.

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