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Bistability characteristics of different types of optical modes amplified by quantum dot vertical cavity semiconductor optical amplifiers

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Abstract: We have studied the characteristics of optical bistability of different types of optical modes amplified by small-size quantum dot vertical cavity semiconductor optical amplifiers operated in reflection. Our analysis reveals that TE01 mode exhibits stronger intensity-dependentn on-linearity in small radius devices, which results in stronger optical phase modulation and therefore larger hysteresis width compared with the other modes.The effect of the wavelength detuning of the input signal on the shape of the hysteresis loop is studied. We find that butterfly hysteresis loop exhibits the largest hysteresis width compared with clockwise and counterclockwise loops. Our analysis reveals that doping the quantum dots with p-type dopings lightly reduces the hysteresis width while doping the dots with n-type doping clearly increases the hysteresis width for anywavelength detuning. We estimate that the hysteresis width of quantum dot active layer will exhibit higher hysteresis width compared with quantum well active layer having the same threshold gain.