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Abstract
Due to its many special physical properties, including ability to increase light absorption and/or decrease light reflection, modulated energy bandgap, high resistivity, huge surface area-to-volume ratio, and the same single-crystalline structure as the bulk-Si, porous silicon (PS) is very suitable for applications in semiconductor optical devices. In this thesis, optical-sensing devices with double-sided porous silicon (DSPS) structures had been studied, in which surface PS layers served as the anti-reflection layers while back-sided PS layers were designed as the light-reflection layers to improve the optical-sensing characteristics of devices.

Experimental results showed that, as compared to the devices with single surface PS layers, devices with DSPS structures got 10-time higher optical current and 160-time lower optical-to-dark current ratio with a shift of peak photo-responsivity from 750 nm to 900 nm. The influences of different porosity of the back-sided PS layers in devices' characteristics were also studied. The measured optical-to-dark current ratio and dark current of devices with back-side porosity of 75.86% are 10-time higher than and 2-time lower than, respectively, those of devices with back-side porosity of 41.35%. The peak photo-responsivities for both devices were 950 nm (40 mA/cm2) and 1000 nm (20 mA/cm2).

Owing to the design of back-sided PS layers, devices' dark current had been significantly restricted because of the increased series resistance, and optical current had been enhanced because of the increase optical path for the photons in the devices. As a result, the developed devices achieved a very high optical-to-dark current ratio. Therefore, DSPS structures has a very high potential in development of high-sensitive optical sensing devices.
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