Responsivity dependent anodization current density of nanoporous silicon based MSM photodetector

ABSTRACT

Achieving a cheap and ultrafast metal-semiconductor-metal (MSM) photodetector (PD) for very high-speed communications is ever-demanding. We report the influence of anodization current density variation on the response of nanoporous silicon (NPSi) based MSM PD with platinum (Pt) contact electrodes. Such NPSi samples are grown from n-type Si (100) wafer using photoelectrochemical etching with three different anodization current densities. FESEM images of as-prepared samples revealed the existence of discrete pores with spherical and square-like shapes. XRD pattern displayed the growth of nanocrystals with (311) lattice orientation. The nanocrystallite sizes obtained using Scherrer formula are found to be between 20.8 nm and 28.6 nm. The observed rectifying behavior in the characteristics is ascribed to the Pt/PSi/n-Si Schottky barrier formation, where the barrier height at the Pt/PSi interface is estimated to be 0.69 eV. Furthermore, this Pt/PSi/Pt MSM PD achieved maximum responsivity of 0.17 A/W and quantum efficiency as much as 39.3%. The photoresponse of this NPSi based MSM PD demonstrated excellent repeatability, fast response, and enhanced saturation current with increasing anodization current density.

Keyword: Anodization; Nanoporous silicon (NPSi); Metal-semiconductor-metal (MSM) photodetector (PD)