PAPER

Plasmonic effect of gold nanoparticles on rear side of flexible black silicon wafer fabricated by aluminum-assisted chemical etching

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Abstract

In this work, we investigate the effects of the different sizes of gold (Au) plasmonic nanoparticles (NPs) on the rear surface of flexible black silicon (b-Si) wafer. The flexible b-Si (65 μm thickness) is fabricated by aluminum-assisted chemical etching (AACE) process, utilizing aluminum (Al) as the catalyst. After the b-Si fabrication, nanopores are produced on the flexible wafer surface. Then, gold nanoparticles (Au NPs) are spin-coated on the rear side of the flexible b-Si, followed by surface morphological and optical characterizations. The Au NPs with sizes of 24–92 nm have been deposited on the rear surface of the b-Si wafer. Based on the optical characterization, light absorbance increases above wavelength 800 nm due to enhanced light scattering by the Au NPs at the back surface. The average reflectance (R_{ave}) is calculated in the 300 nm–1100 nm wavelength range for flexible crystalline silicon (c-Si) reference and compared with flexible b-Si surface and flexible b-Si/Au NPs. The lowest R_{ave} of 15.4% is achieved for Au NPs with average size of 92 nm.