Near-field photocurrent measurements are applied to the diagnostics of the $p$-$n$ junction of semiconductor devices beyond the diffraction limit of light. In order to probe the internal properties of these devices, modes of propagation into the sample are utilized, retaining high resolution as a result of the contribution of a penetration depth smaller than the aperture diameter of the probe. Near-field photocurrent measurements with multi-wavelength excitation are applied to investigate a lateral $p$-$n$ junction grown on patterned GaAs(111)A. The slant angle of the $p$-$n$ junction interface is determined to be $30\pm8^\circ$. The minority carrier diffusion lengths of the electron $L_n$ and the hole $L_p$ of the Si $p$-$n$ junction are estimated to be $0.47\pm0.03$ and $0.37\pm0.02$ $\mu$m, respectively. Near-field photocurrent measurements are also applied to the $p$-$n$ junction on a Si substrate under the reverse-bias condition in order to estimate the dopant concentration of the $p$-$n$ junction. The full-width at half maximum (FWHM) of the cross-sectional profile of the near-field photocurrent signal varied upon changing the applied reverse-bias voltage, according to the resulting change in the thickness of the depletion region. From the measured reverse-bias dependence of the FWHM of the cross-sectional profile, the local dopant concentration of the Si substrate was estimated to be $3.5\pm0.4\times10^{16}$ cm$^{-3}$. This result shows good agreement with the dopant concentration ($3.1\times10^{16}$ cm$^{-3}$) evaluated from the device specifications for device fabrication.