# $p$-Si/$SiO_x$(Si)&$Al_yO_z$(Al) nanocomposite structure for IR–THz detection with shifted infrared peak sensitivity

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The creation of broadband photodetectors capable of operating in both infrared (IR) and terahertz (THz) spectral ranges is an important objective in modern optoelectronic research. Devices that respond to radiation across such an extended spectral region can simultaneously provide information from both the IR and THz domains, which significantly broadens their potential technological and scientific applications. Many materials suitable for detecting radiation in both IR and THz regions, but achieving higher performance, lower costs as well as miniaturization and integration with complementary technologies remains a persistent challenge.

The ~100 nm depth $SiO_x$(Si)&$Al_yO_z$(Al) active layers on *p*-Si substrate were integrated with metallic bow-tie antennas by depositing an ~1 μm thick aluminum layer using thermal evaporation, followed by photolithography and subsequent chemical processing. AFM studies revealed a well-developed non-uniform surface morphology of $SiO_x$(Si)&$Al_yO_z$(Al) nanocomposite films with surface roughness parameters of Ra = 20–30 nm and Rq = 30–40 nm (fig.1).

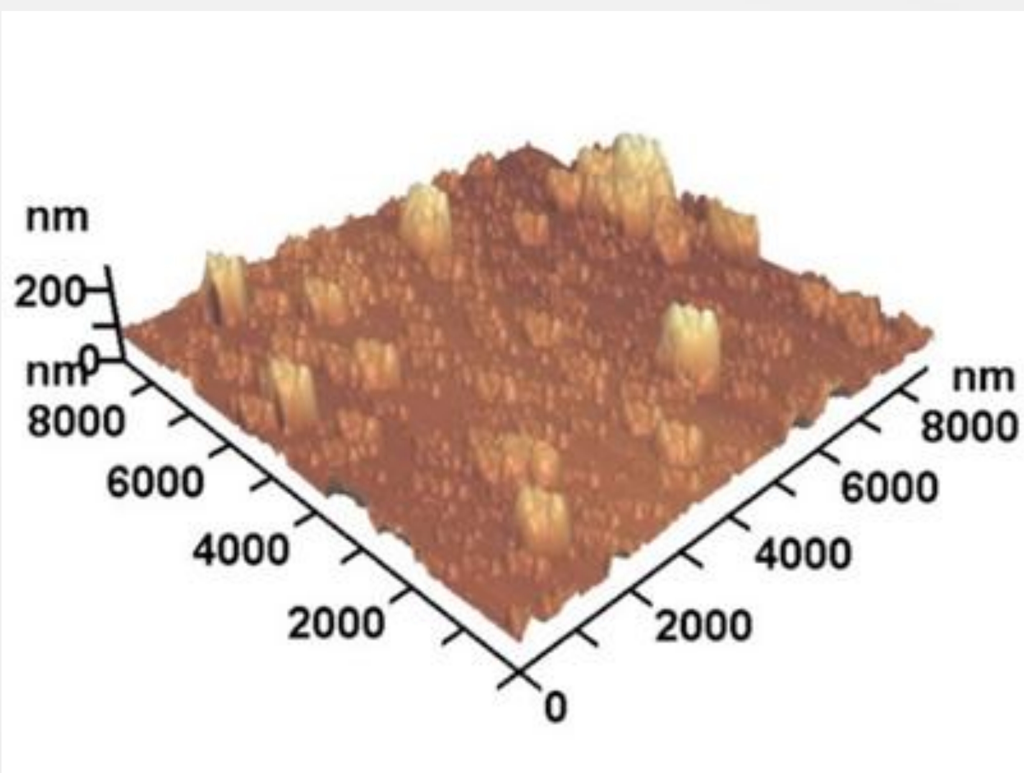


*Fig. 1. 3D AFM image of the surface of $SiO_x$(Si)&$Al_yO_z$(Al) film.*

In the present study, the response of these structures to IR radiation is investigated. The results of the spectral sensitivity measurements of the sample in the 0.7–5 μm range, as well as the surface uniformity of photosensitivity of the detectors in the infrared range (using an optical probe with a radiation source wavelength of 940 nm and a spot diameter of approximately 60 μm), are shown in Figure 2. The shift of the spectral sensitivity maximum toward longer wavelengths is attributed to the presence of oxide phases, impurities, and structural features of varying sizes in the nanocomposite, which can introduce energy levels within the band gap and enable absorption of photons with lower energy.

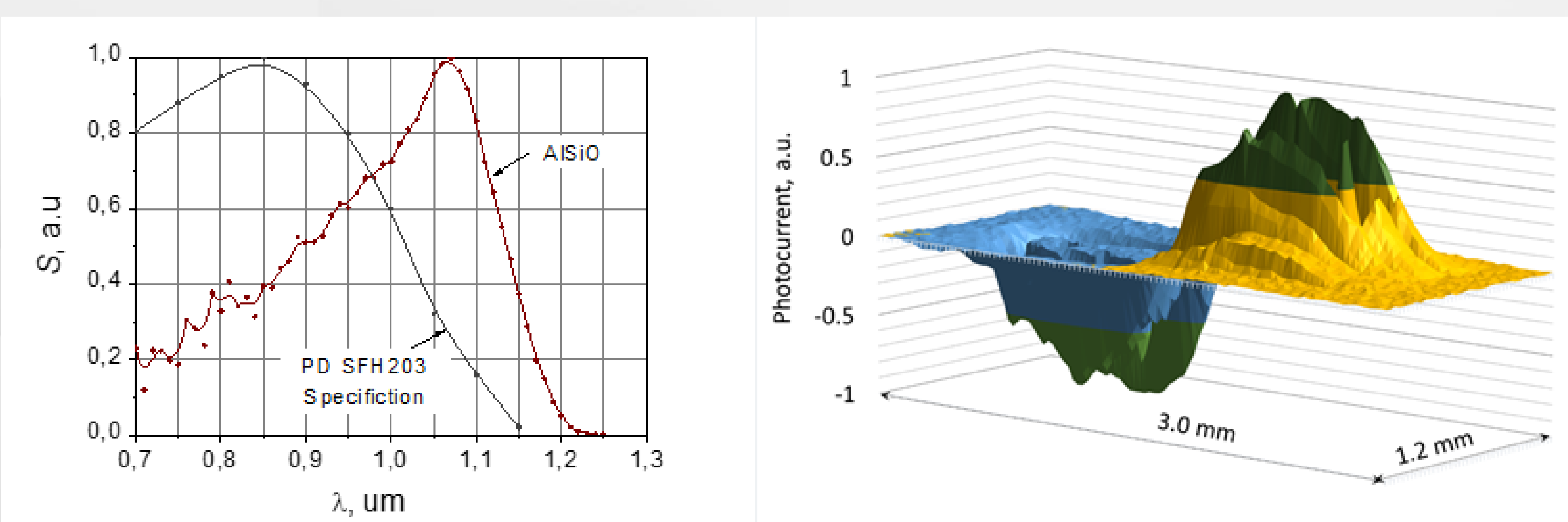


*Fig. 2. Spectral sensitivity of the investigated sample compared to the SFH203 photodiode (OSRAM) and its photosensitivity map across the surface.*

The obtained results indicate strong potential of these nanocomposite films for multifunctional optoelectronic and sensing applications.

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