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Low emissivity double sides antireflection coatings for silicon wafer at infrared region

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ABSTRACT

Silicon wafer, when operating from the band edge to the far infrared, inherently possess nearly polarization-independent low intrinsic loss - an appropriate infrared transmission window sheet for infrared devices. However, the incident light is mostly reflected at the silicon-air interface due to large admittance mismatch. We show that the reflection of silicon wafer may be sufficiently suppressed by utilizing a double sides non-quarter wave anti-reflective coatings (ARCs). The underlying mechanism is that the interfaces of the ARCs with the silicon wafer and the air structure are selected such that the matched admittance has a real value. For an optimized double sides ARCs, we achieve a lowest light reflectance of ~4% over a broad infrared spectral range at various light incident angles, which is superior to a single side admittance-matched ARCs. We further demonstrate that, compared with bare silicon wafer, the observed infrared normal spectral emissivity of the silicon wafer with the double sides ARCs increased by only ~0.02. As the advantages above are not at a cost of surface modification, this structure is promising to be applied in low emissivity infrared window for radiation thermometry, sensing, and so on.

Keywords: Infrared emissivity; Antireflection coating; Nanostructures; Optical properties.

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