

Thermal Radiation Properties of a Self-Assembled Silica Photonic Crystal

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We have investigated the thermal radiation properties of a crystal self-assembled with silica particles of 3-5 micro meter diameter. The thermal radiative properties of a self-assembled photonic crystal with defects were different from those of a perfect photonic crystal in our previous numerical work using RCWA method. The enhancement of normal spectral absorptance was shown only for the photonic crystal with defects in the calculation result. The emittance is the same as the absorptance according to the Kirchhoff's law. For the verification of the simulation result and exploration of the mechanism of the absorptance enhancement, we developed a measurement system for thermal radiative properties of the fabricated photonic crystals. In this study, we measured the normal spectral emittance and the normal-hemispherical spectral reflectance of the fabricated silica photonic crystals by a FTIR with paraboloidal mirror. We also measured the the normal-hemispherical spectral reflectance of the sample using an integrating sphere reflectometer to confirm the measured results. The self-assembly fabricated photonic crystal was heated up to 523K for the emittance measurements using a FTIR. The normal-hemispherical spectral reflectance was measured by using an integrating sphere reflectometer to confirm the validity of the normal spectral emittance measurement. The measured normal spectral emittance of the photonic crystals of silica particles in 3 micro meter diameter was increased in the vicinity of 3 micro meter. The measured enhancement was agreed well with the results numerically calculated by RCWA method. The measured normal-hemispherical spectral reflectance was decreased in the same wavelength. The validity of the normal spectral emittance measurement by FTIR was confirmed. The normal spectral emittance can be enhanced by using the photonic crystals with defects, although such enhancement in the emittance cannot be expected in the perfect photonic crystals.