Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

STT071-02 Room: 201A Time: May 27 09:15-09:30

Effects of silicic spheres for the suppression of radiation heating using on electromagnetic wave scattering theory

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The temperature of external materials of buildings rises when they are exposed to sunlight, and the room temperature rises due to heat conduction. Therefore the crisis of electric power supply is frequently caused by air conditioning in midsummer. Recently, it has been experimentally confirmed that such temperature rising of building materials could be suppressed when they are coated with paint including fine silicic spheres whose diameters are in micron to submicron scale. So we are able to reduce the energy consumption if room temperature is controlled not with any air conditioning but with these paints, and the heat island effects would be lowered. However, the mechanism of this temperature suppression has not been investigated. Experimental consideration of this paint has been done, but the mechanism how the paint controls the temperature rise has hardly been clarified theoretically. Since the best composition of the spheres and their best size are not understood well, it is necessary to theoretically clarify the controlling mechanism for the temperature rise to develop efficient paint. In this study, we aimed to find out the mechanism of the temperature suppression. Here, we consider electromagnetic wave of light. Then we assumed that the electromagnetic waves in a certain range of frequencies were scattered to shield the radiated heat energy in the insolation and that the transmitted light through the paint layer is weakened. For verifying this, we used the Mie theory of a light scattering theory to calculate the intensity of scattered light from a set of packed spheres. As a result, we can clarify the scattered strength distribution with single sphere. We also confirmed the existence of cases that an incident wave and the scattered wave strengthened or weakened each other. These calculated results lead us to explain phenomena with actual paint.

Keywords: scattering, electromagnetic wave, silicic spheres, Mie theory