Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Experimental investigation of the thermal insulation performance of Ce/Si/Ti oxide heat-reflective coating

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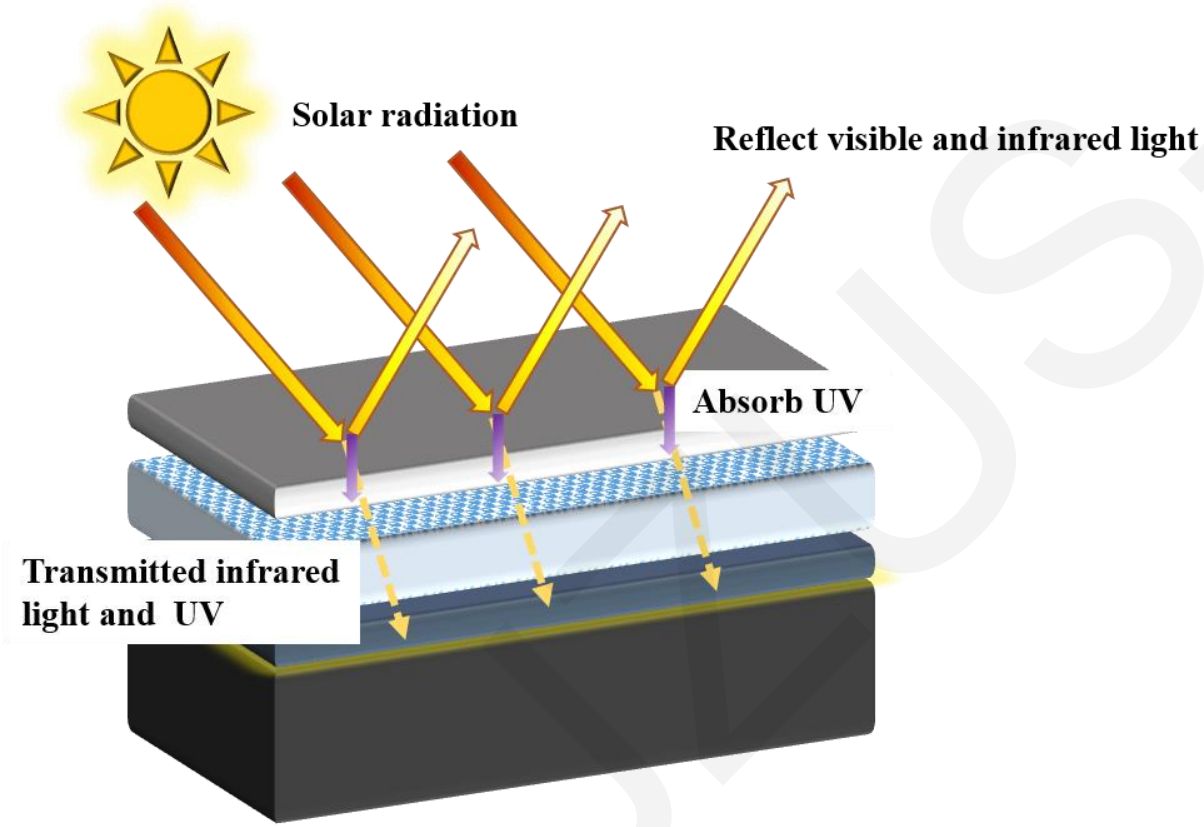
Cite this as: Rui SU, Yue LV, Qian SU, Yanfei PEI, 2023. Experimental investigation of the thermal insulation performance of Ce/Si/Ti oxide heat-reflective coating. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 24(10):912-924. https://doi.org/10.1631/jzus.A2200550

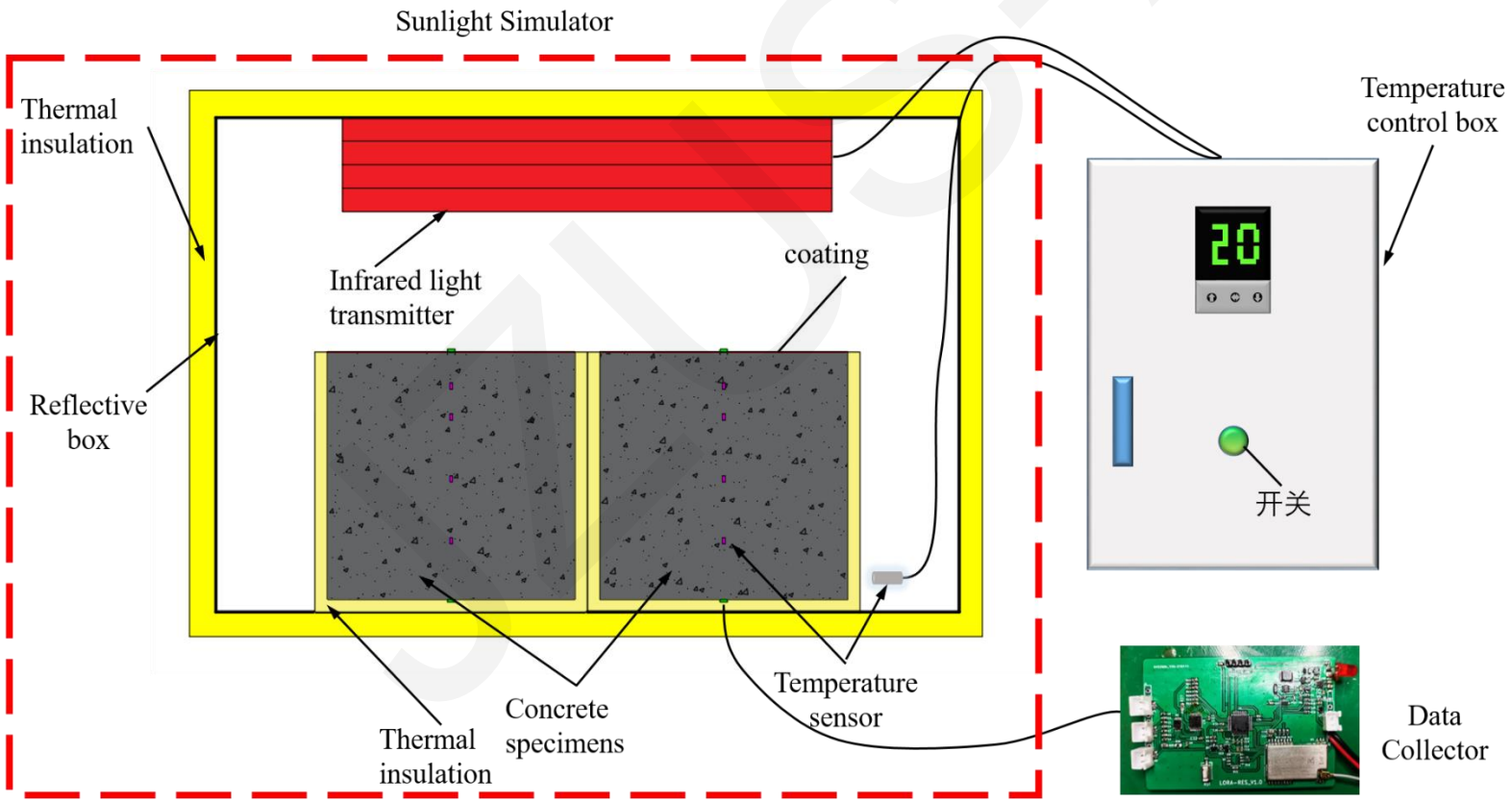
Coating structure



- The top layer is able to isolate dust, water, acid, alkali and ultraviolet rays from the natural environment and protects the coating from environmental erosion.
- The middle layer has the function of reflecting sunlight and blocking heat transfer.
- The bottom layer is able to increase the bonding between the concrete track slab and the coating structure.

Solar simulation system

- **The sunlight simulation box consists of a reflective box, a thermal insulation layer and an infrared light emitter.**



Experimental procedure



Preparation of TiO_2@SiO_2@CeO_2 with a reactor



Paint preparation



Coating



Coating adhesion test



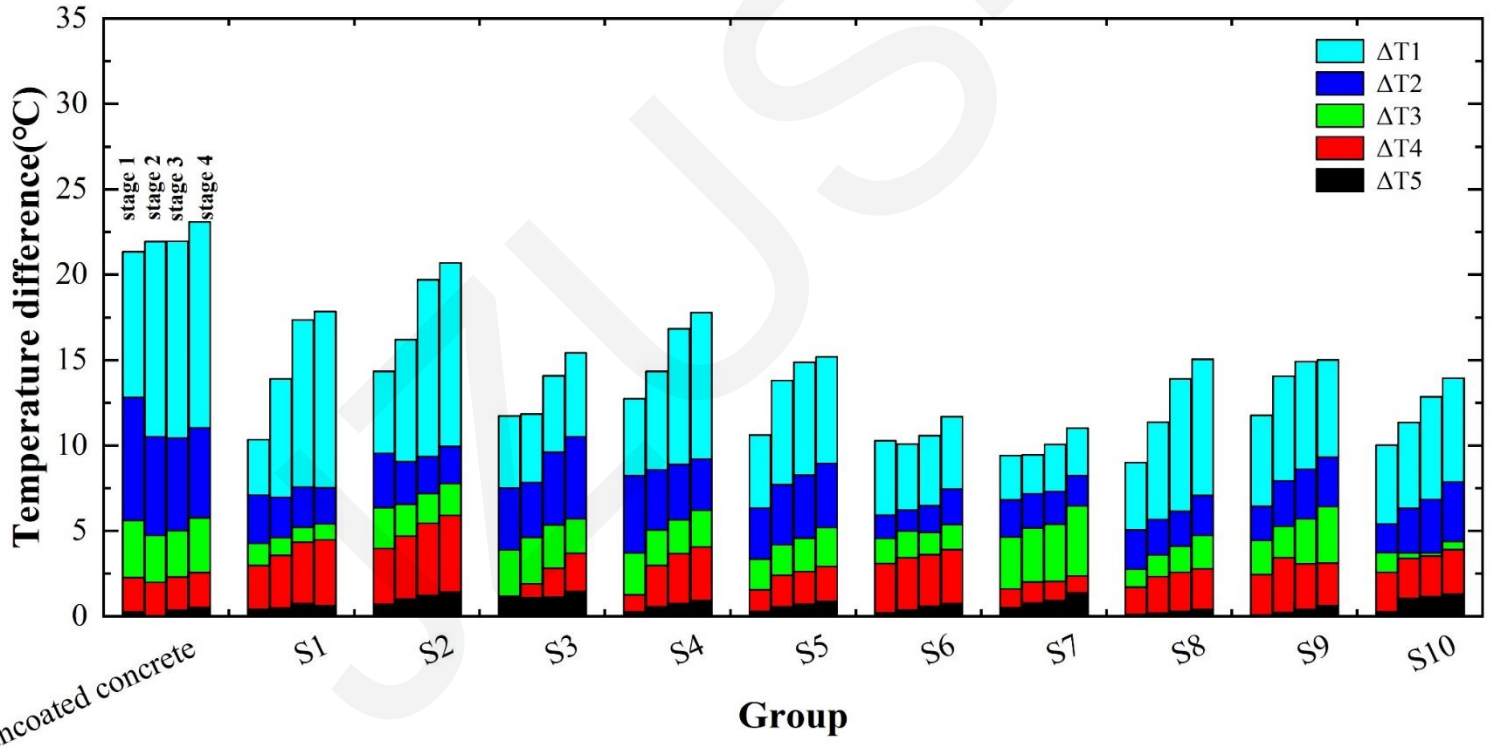
Set up the temperature sensor



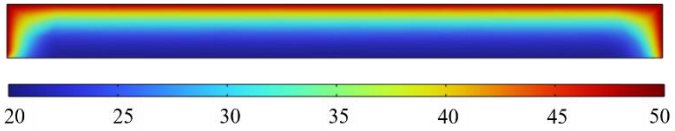
Thermal insulation test

Temperature gradient in concrete sample

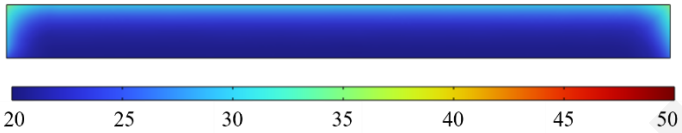
- **The cumulative temperature difference inside the concrete is lowest when the Ce/Si/Ti oxide contents are 33% and 40% (S6, S7).**



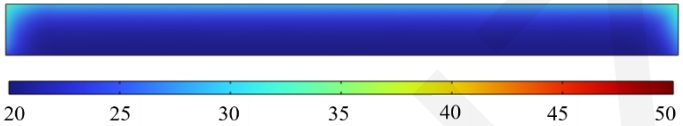
Temperature distribution of the track slab



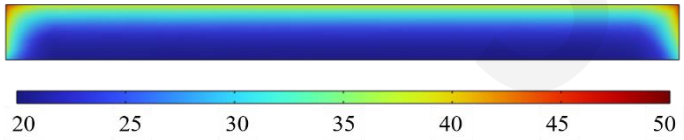
uncoated



S7



S8



S10

- **The temperature of the outer surface of the track slab is equal to the external ambient temperature and the temperature decreases sharply inwards, resulting in a large difference between the internal and surface temperature of the track slab.**
- **The surface temperature of the track slab decreases by different amounts after the coating is applied, and the highest temperature points appear at the four corners of the track slab.**

Conclusions

- The thermal reflection coating can reduce the surface temperature and internal temperature difference of the track board by 11.54~21.31 ℃. When the Ce/Si/Ti oxide content is 40%~50%, the coating has excellent cooling effect, which can reduce the surface temperature of the track board by 70%, the temperature difference by about 40%, and the vertical displacement of the track board by about 70%.

- Taking into account the thermal insulation rate of the coating, the internal temperature difference of the concrete and the adhesion strength of the coating, as well as the deformation control effect of the track slab, the optimal amount of Ce/Si/Ti oxide is 40% and that coating is the most suitable for the thermal insulation coating of the track slab.