

Reduction of Reflected Heat of the Sun by Retroreflective Materials

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We are proposing to use **retroreflective materials** as an anti-heat island measure.

Outline of my talk

- 1) **Key idea:** Why **retroreflective materials** are effective “*especially*” in Osaka?
- 2) **Demonstration:** the anti-heat island effect of **retroreflective materials**.
- 3) **Evaluation:** How to evaluate the **retroreflective** properties.



Where is Osaka?



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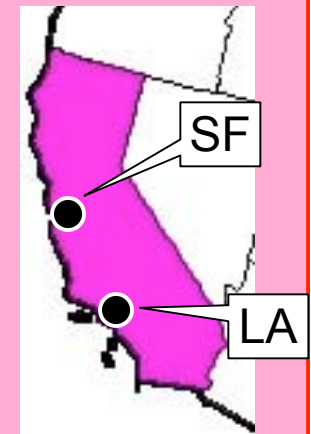
Where is Osaka?

Osaka in summer
35°C(95F) daytime, 25°C(77F) night.



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Ginza, the central part of Tokyo (JAPAN)

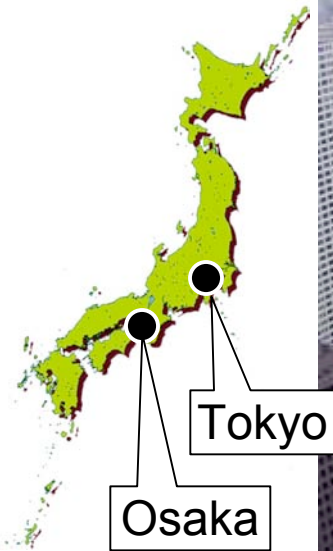


photo: Sakai, 4 Aug 2009

Umeda, the central part of Osaka (JAPAN)

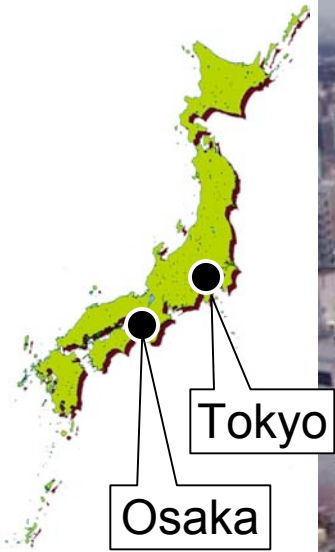
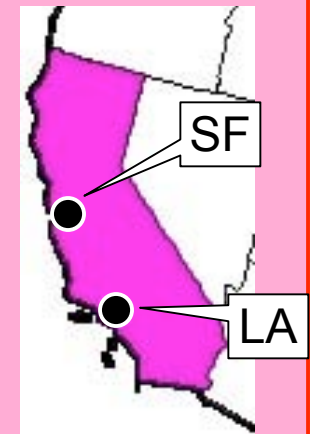


photo: Sakai, 17 Jul 2005



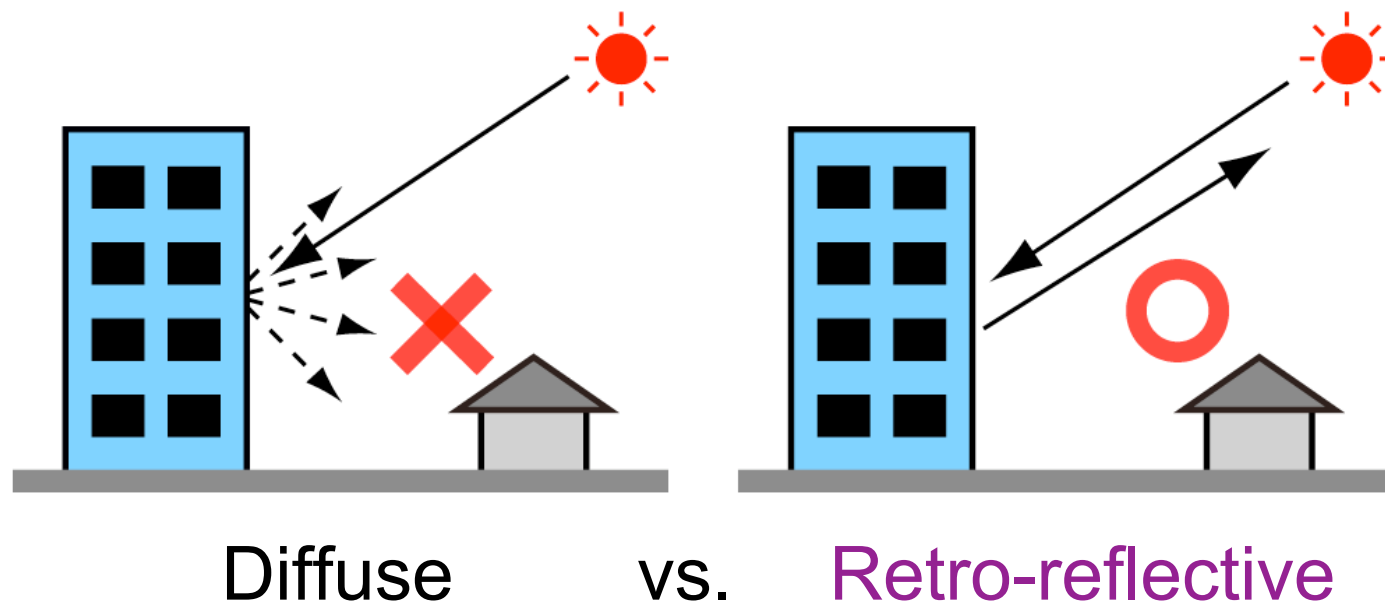
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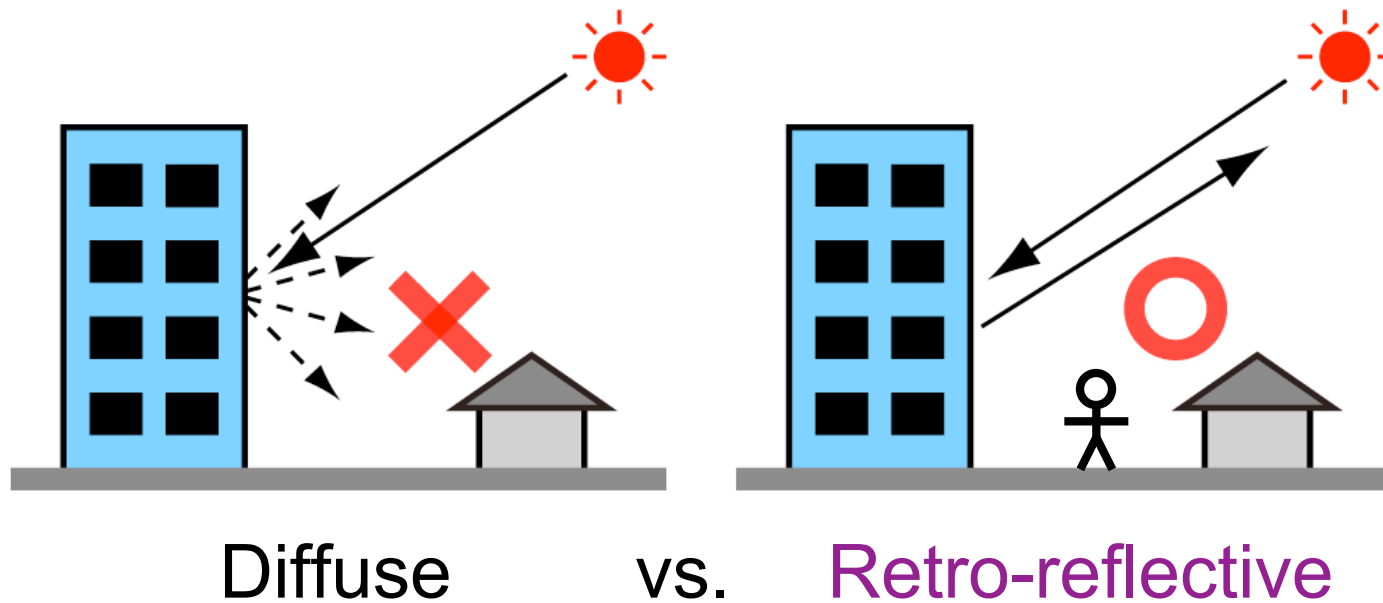
Key idea of our study

High reflective materials are used to reduce the amount of solar heat absorbed by building surfaces.

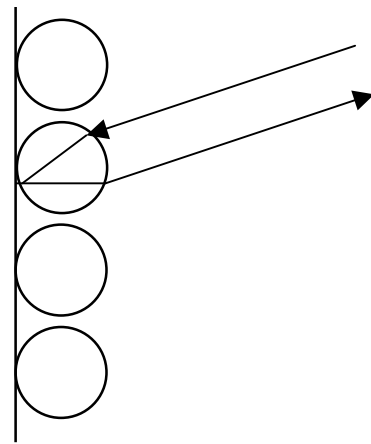


Key idea of our study

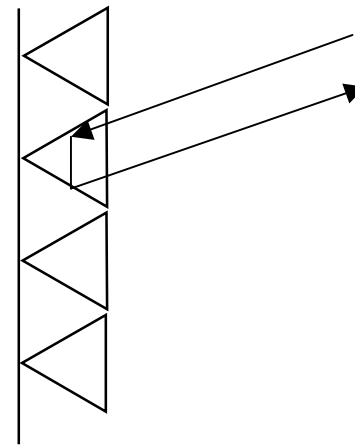
High reflective materials are used to reduce the amount of solar heat absorbed by building surfaces.



Retroreflection: returns light back to its source

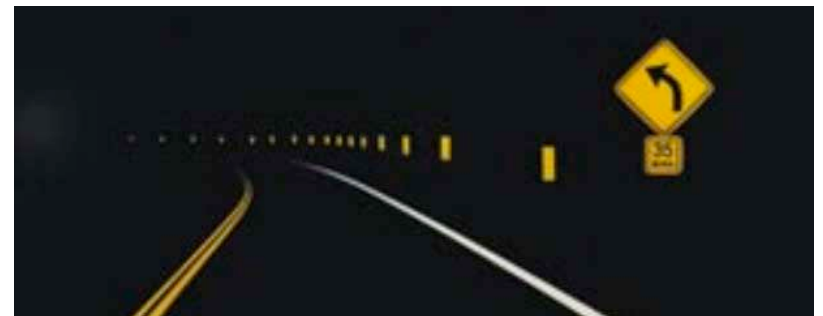


ball lens optics
(beads)



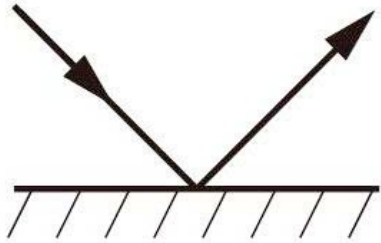
corner cube optics
(prism)

They are used as the road markings and signs to enhance night-time visibility.

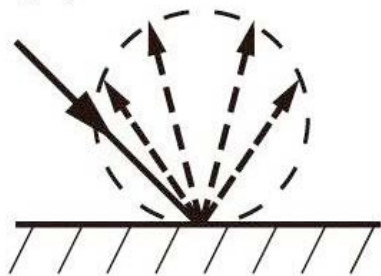


Experimental Setup: Miniature model of urban canopy

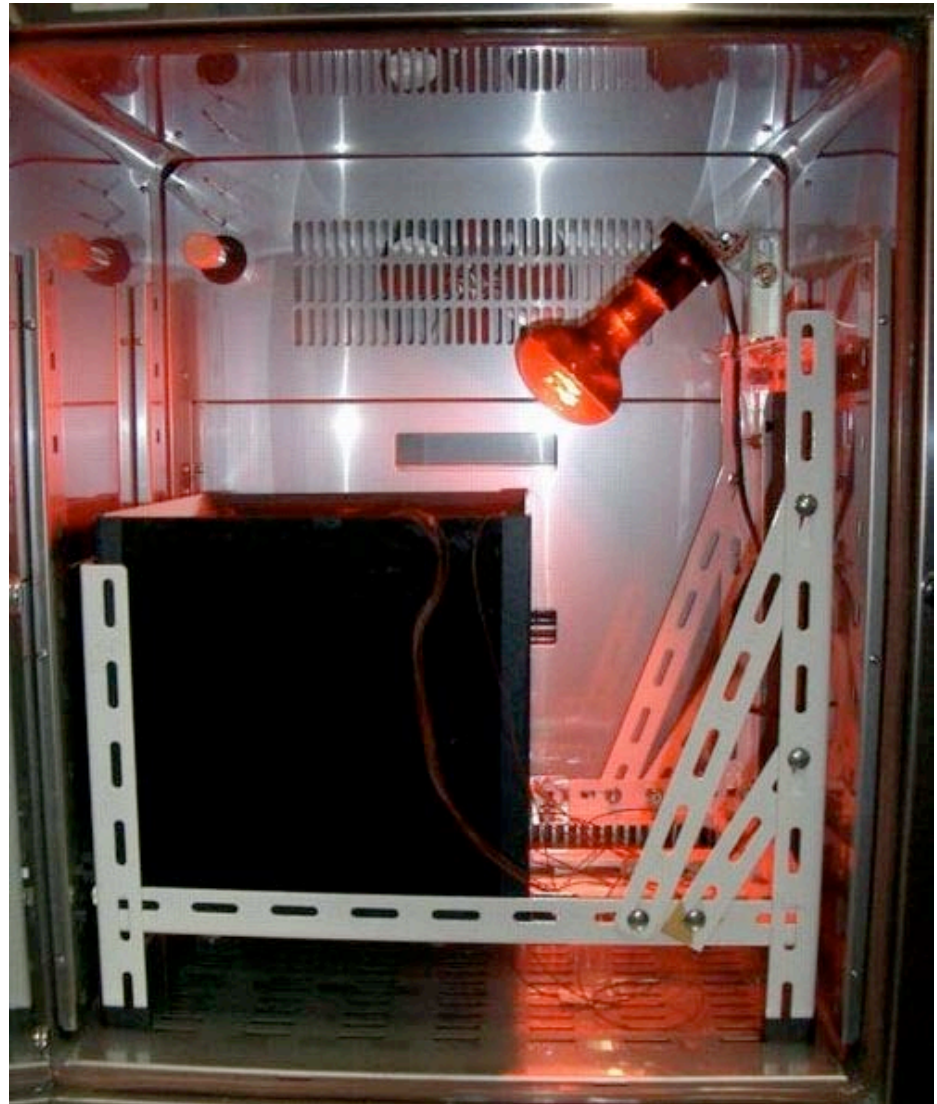
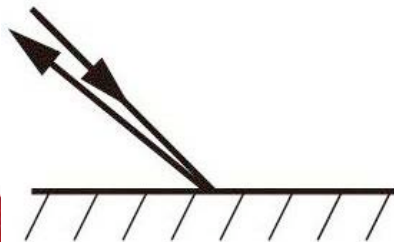
(a) Specular reflection



(b) Diffuse reflection

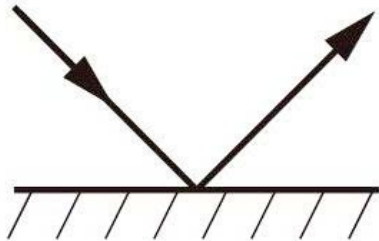


(c) Retroreflection

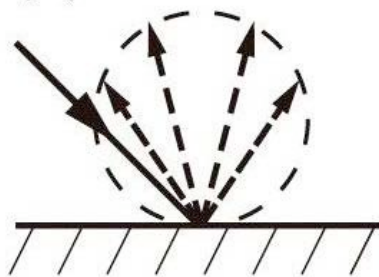


Experimental Setup: Miniature model of urban canopy

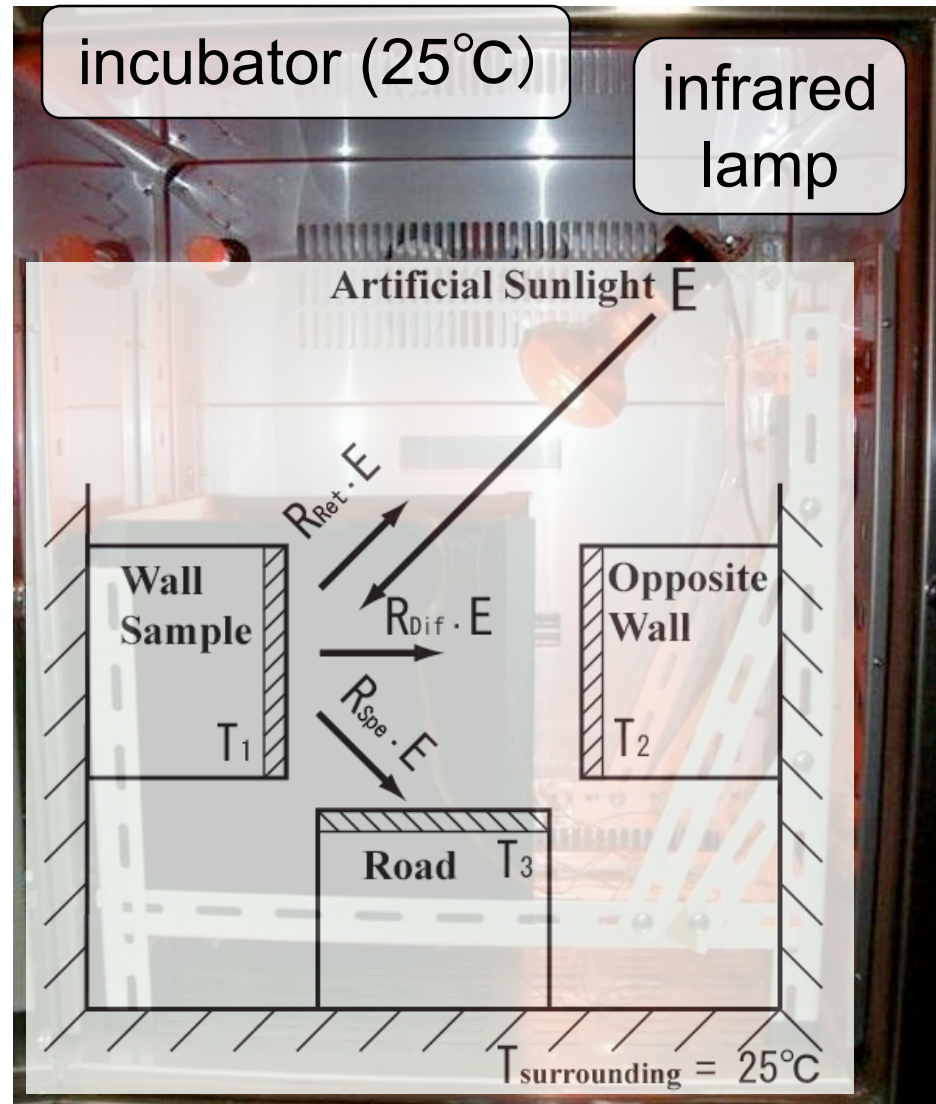
(a) Specular reflection



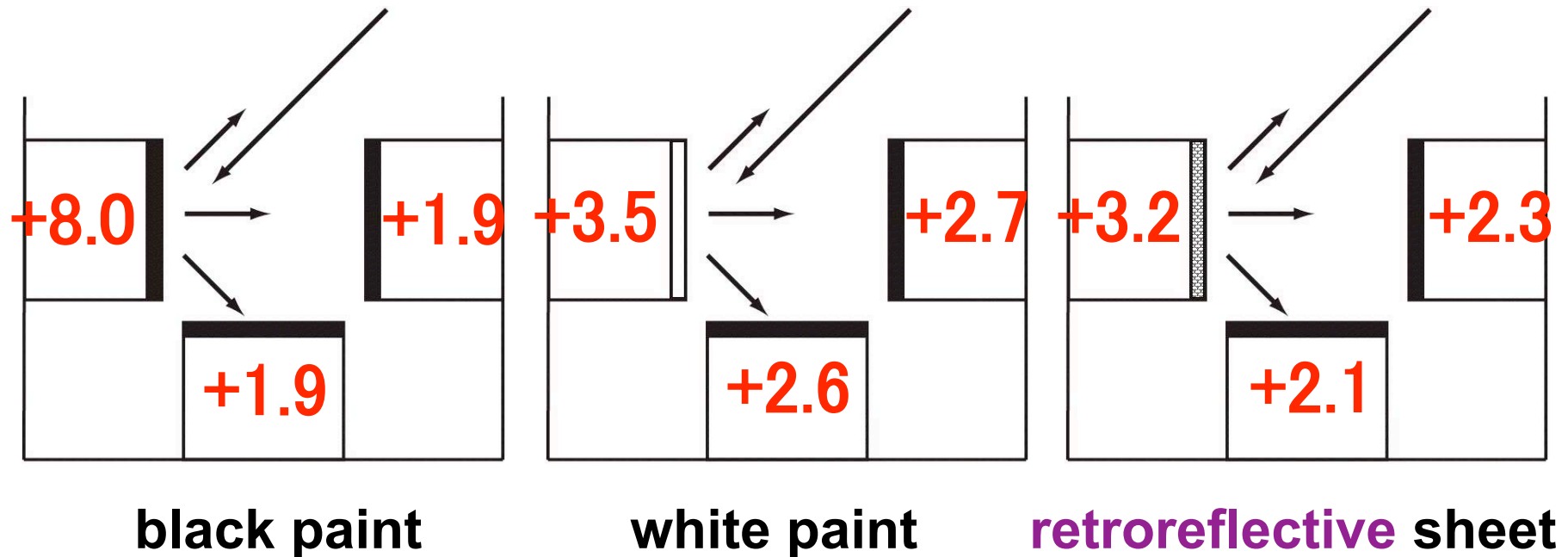
(b) Diffuse reflection



(c) Retroreflection



Experimental Result: Rise in Temp. by Irradiation

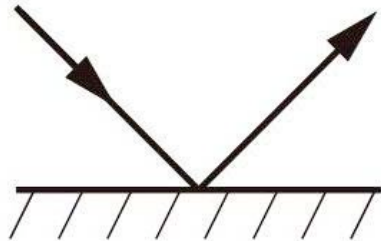


Retroreflective surfaces can reduce the absorbed heat and the reflected heat.



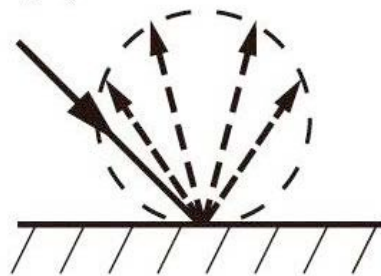
Retroreflectance Measurement

(a) Specular reflection



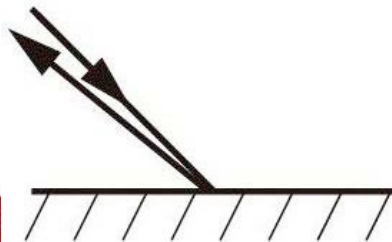
R_{Spe}

(b) Diffuse reflection



R_{Dif}

(c) Retroreflection



R_{Ret}



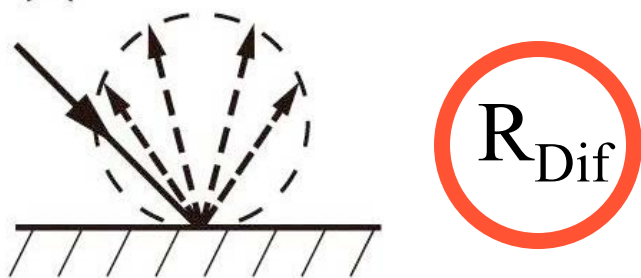
Integrating Sphere Measurement

Retroreflectance Measurement

(a) Specular reflection



(b) Diffuse reflection

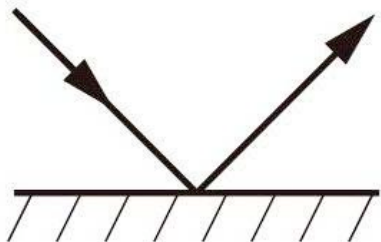


(c) Retroreflection



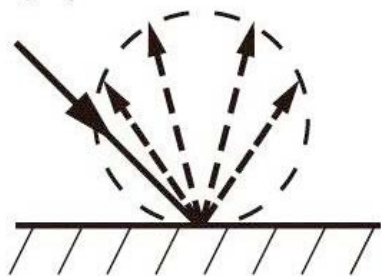
Retroreflectance Measurement

(a) Specular reflection



R_{Spe}

(b) Diffuse reflection



R_{Dif}

(c) Retroreflection



~~R_{Ret}~~



Integrating Sphere Measurement

$$R_{\text{Tot}} = R_{\text{Spe}} + R_{\text{Dif}} + R_{\text{Ret}}$$

$$R_{\text{Ret}} = R_{\text{Tot}} - R_{\text{Spe}} - R_{\text{Dif}}$$

Future of Retroreflective materials

Score table

	Reduction of Absorbed Heat	Reduction of Reflected Heat	Cost
High-reflective	○	△	○
Retroreflective	○	○	△
Movable mirror	○	○	×



Summary

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