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Task 1: In you own words (which means in your own words) write a summary of the topics about radiative heat transfer we went through including the definitions of emissivity, absorptivity and reflectivity, the view factor, the heat exchange betweeen two black surfaces,the heat exchange between the two gray surface and finally the definition of radiative resistances

Radiative Heat Transfer

Emissivity:

Definition:

The ratio of the radiation flux emitted per unit area on the surface of an object to the radiation flux emitted by the black body at the same temperature.

The ratio of the radiation emission of an object to that of an absolute black body at the same temperature and wavelength. It shows that the actual thermal radiation of the object is close to that of the black body. It is one of the important basic factors that affect the surface temperature.

Influencing Factors:

The specific emissivity varies with the dielectric constant, surface roughness, temperature, wavelength and observation direction, and its value is between 0 and 1.

Generally speaking, it can be summarized as the function of surface object type (roughness), temperature, (with the measured radiant energy) wavelength, and change with the measured radiant energy wavelength, observation Angle and other conditions.

Absorptivity:

Definition:

A measure of a substance's ability to absorb light at a given wavelength, expressed by the symbol epsilon.

For a medium with selective absorption in the visible light region, it represents the sensitivity of a certain color reaction. For the same measured element, the greater the sensitivity, the more sensitive the color reaction will be. For the same color reaction, the sensitivity is related to the measured concentration. The molar absorption coefficient usually refers to the molar absorption coefficient at the maximum absorption wavelength.

Influencing Factors:

The size of the molar absorption coefficient is related to the properties of the substance to be measured, the solvent and the wavelength of light.

Therefore, the molar absorption coefficient can be used as the characteristic constant of the substance. Solvent is different, the same substance of the molar absorption coefficient is different, therefore, in the description of the molar absorption coefficient, should indicate the solvent. The absorption coefficient of light varies with the wavelength of light. The higher the purity of monochromatic light, the larger the molar absorption coefficient.

Reflectivity:

Definition:

The amount of radiant energy reflected by an object as a percentage of the total radiant energy is called reflectivity.

Influencing Factors:

The reflectivity of different objects is also different, which mainly depends on the nature of the object itself (surface condition), as well as the wavelength of incident electromagnetic wave and incident Angle. The range of reflectivity is always less than or equal to 1, and the reflectivity can be used to judge the nature of the object

View Factor:

The view factor, is a geometrical quantity corresponding to the fraction of the radiation leaving surface i that is intercepted by the surface j.

It does not depend on the surface properties.

It is also called shape factor, configuration factor, and angle factor.

·Heat Exchange (between two Black Surfaces):

The heat exchange between two black surfaces refers to the process in which one black surface emits radiation to another black surface and is completely absorbed, while the other black surface also emits radiation and is also completely absorbed by the first black surface. Can be expressed by a formula: A1Eb1F1-2- A2Eb2F2-1, (A represents the area of the black surface, Eb represents the amount of radiation emitted per unit area per unit time, F represents the view factor), and applying the reciprocity relation: A1F1-2= A2F2-1, so $\dot{Q}_{1\to 2} = A_1 \times F_{12} \times \sigma\,(T_1^4 - T_2^4)$.

·Heat Exchange (between the two Gray Surface):

Unlike black surface, the heat exchange between two gray surfaces absorbs and reflects only a portion of the radiation. A gray surface i emits radiation to another gray surface j, radiation leaving the entire surface i that strikes surface j subtracts radiation leaving the entire surface j that strikes surface i. Can be expressed by a formula: $A_iJ_iF_{i\text{-}j}$- $A_jJ_jF_{j\text{-}i}$, (A represents the area of the black surface, J represents the amount of radiation emitted per unit area per unit time, F represents the view factor), and applying the reciprocity relation: A1F1-2= A2F2-1, so $\dot{Q}_{i\to j} = A_i \times F_{i-j} \times (J_i - J_j)$.

Radiative Resistances:

The radiative resistance is a value used to measure the loss resistance energy, and the loss energy is converted into heat radiation; the energy lost by the radiative resistance is converted into radio waves.

Task2: Solve the last example you solved in the class (radiative heat exchange between two parallel plates) awhile considering the two emissivities to be 0.1, what can you conclude from the result?

Question:

Find the net heat exchange between the surface 1 and 2 where A1 = 1.5 m2, F12 = 0.01, T1 = 298 K, T2 = 308 K, $\boldsymbol{\epsilon_1}$=0.1, $\boldsymbol{\epsilon_2}$=0.1, $\boldsymbol{\sigma}$=5.67*10-8$\frac{\boldsymbol{W}}{\mathrm{m}^2\cdot\boldsymbol{K4}}$.

Solve the last example in the class (radiative heat exchange between two parallel plates) awhile considering the two emissivities to be 0.1, what can you conclude from the result?

Solution:

$\dot{Q}_{1\to2} = \frac{A_1\sigma\,(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}-1}$ = $\frac{1.5*\mathbf{5.67}*10^{-8}*\,(308^4\,-298^4\,)}{\frac{1}{0.1}+\frac{1}{0.1}-1}$ = 4.9821W

$F_{12} = \frac{1}{\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}-1}$ = $\frac{1}{\frac{1}{0.1}+\frac{1}{0.1}-1}$ = 0.0526

The example solved in the class:

F_{12} = 0.01

$\dot{Q}_{1\to2} = A_1 \times F_{12} \times \sigma\,(T_1^4 - T_2^4)$ =1.5*0.01*5.67*10-8*(2984-3084) =-0.9466 W

$\dot{Q}_{2\to1} = -\dot{Q}_{1\to2} =$ 0.9466 W

Conclusion:

From the result, we can see that when the value of emissivity increases, the view factor will increase more obviously, and the value of radiative heat transfer will also increase significantly.