Cavity Radiation

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Objective:

Utilize the Cavity Radiation Experiment to measure and compare the amount of radiation emitted by different surfaces of an object to the amount of visible light reflected off said surfaces.

Background:

Perfect Blackbodies-
Theoretical objects that absorb 100% of approaching radiation. They appear perfectly black, reflecting no absorbed radiation.0
Actual Blackbodies-
Absorb incident E.M radiation (wavelengths; light), and emit thermal radiation (heat)
Radiation and Emittance-
Blackbody Radiation, Wein's Law:
As T increases, peak wavelength decreases
[$\lambda max=c/T$ }
Light Intensity Emitted, Stefan's Law:
As T increases, total energy also increases, (the area under the curve)
[$P/A = I = \varepsilon\sigma T4$]
ε, Emissivity; effectiveness in emitting energy,
Perfect Blackbodies, ε = 1, Otherwise, ε < 1

Formulas:

$I=P_{rad}/A=\mathcal{E}\sigma T^4$

$\lambda_{max}=(0.002898m*K)/(T)$

$I_{RJ}=(2\pi ckT)/(\lambda^{4})$

$I(\lambda,T)=(2\pi e^2h)/(\lambda^5) * 1/(e^{(hc/\lambda kT)}-1)$

I ⇒ intensity

Ɛ ⇒ emissivity

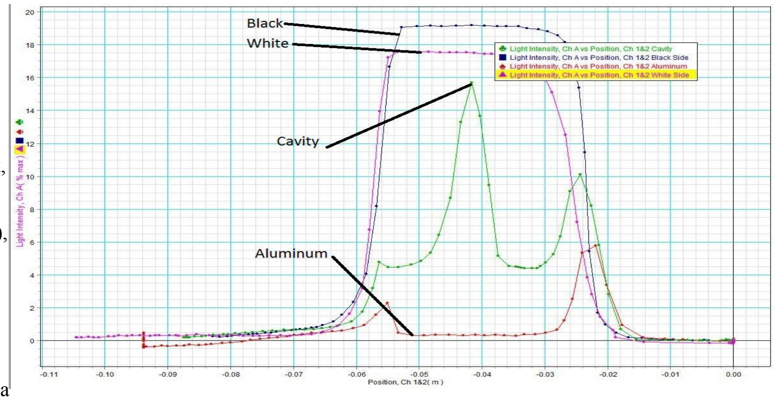
σ ⇒ 5.6703 E-8

T ⇒ temperature (K)

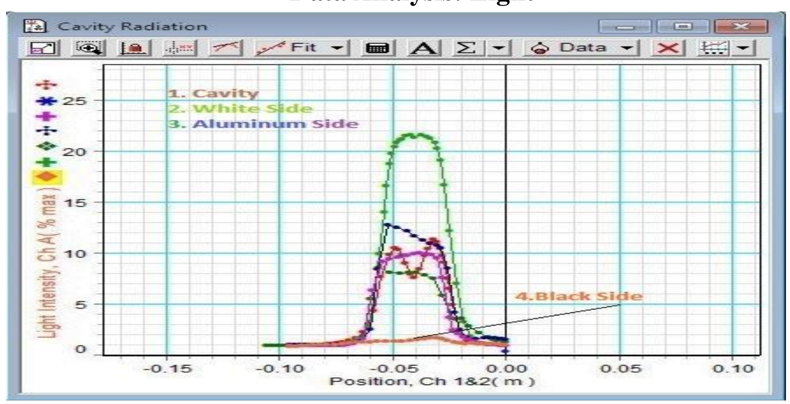
λ ⇒ wavelength

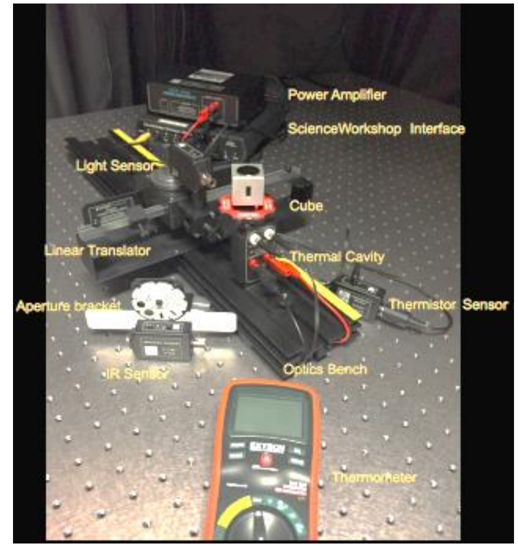
K ⇒ Boltzmann's Constant

Data Analysis: Infrared



Data Analysis: Light





Procedure:

1. Orient cube so cavity faces light sensor, 2 cm to right or left of it
2. Slide the light sensor across the cube by rotating the rotary motion sensor pulley
3. Click "STOP" in DataStudio, record the temperature of the cube, and find λmax
4. Rotate the cube to next consecutive side until all four sides are scanned.

Error:

Scratches on the surface of the cube. The temperature readings did not always match those of the thermometer. The light source was not a point source. There were external radiation sources, such as human hands. The light source was misaligned.

Conclusion:

The black and white side of the cubes are both good emitters of infrared radiation, but the black side has a slightly higher intensity than the white. They are opposite when it comes to light reflected. The radiation emitted inside the cavity is greater than the radiation emitted on the surface. The radiation is trapped inside the cavity allowing it to absorb more. The light emitted outside on the surface is greater than the light in the cavity. The light is trapped in the cavity and is not emitted out.