Chapter 8: Blackbody Radiation

Overview

The objective of this experiment is to verify the Stefan-Boltzmann law (that power per unit area radiated is proportional to temperature to the fourth power), and to determine the emissivity of tungsten.

Suggested Reading Assignment

The section on "Blackbody Radiation" in your modern physics text.
E.g., Section 3-2 of Tipler and Llewellyn, 4th edition.

Pre-lab Questions

1. Explain the term "black body radiation". Does it apply to objects that appear black only? What is "black" about a "black body"?
2. What was the "ultraviolet catastrophe"? How does quantum theory resolve this problem?
3. Look up Planck's black body spectrum equation for the energy per unit volume, per unit frequency, in an electromagnetic field at equilibrium temperature T.
4. Starting with Planck's radiation Law, derive the Stefan-Boltzmann law. Symbolically, what is σ in terms of h, c, and k?
5. What is Wien's displacement law?
6. Starting with Planck's radiation Law, derive Wien's displacement law for the wavelength at which the black body energy density is a maximum. You will need to numerically solve a transcendental equation (perhaps using Excel's "solver"). Be sure that your numerical result is accurate to at least three significant figures.