

Incandescent Light Bulbs

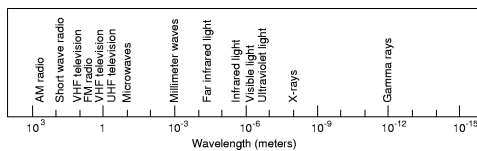
Question:

An incandescent light bulb contains some gas along with the filament. How would removing this gas affect the bulb's energy efficiency?

- Make it more efficient
- Make it less efficient
- No change

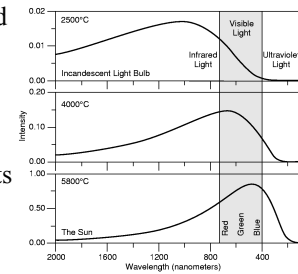
Thermal Radiation

- All materials contain electric charges
- Thermal energy makes these charges accelerate
- Accelerating charges emit electromagnetic waves
- All materials emit electromagnetic waves



Black Body Spectrum

- The spectrum and intensity of electromagnetic waves from a black body depend only on its temperature



Incandescent Bulb

- Features:
 - Tungsten filament produces light
 - Electrical connections deliver power to filament
 - Glass envelope protects filament
 - Nitrogen/Argon/Krypton gas fill prolongs life

Operation Issues (Part 1)

- Filament temperature
 - Determines color temperature and efficiency
 - Higher temperature yields higher efficiency
 - Higher temperature shortens filament life
- Filament heating
 - Electrical heating
 - Requires thin wire at higher voltages

Operation Issues (Part 2)

- Filament reactivity
 - Tungsten is reactive
 - Tungsten needs protection from oxygen in air
- Filament sublimation
 - At high temperatures, tungsten atoms sublime
- Non-reactive gas added to limit sublimation
 - Gas bounces tungsten atoms back onto filament
 - Gas leads to convective heat loss

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Halogen Bulb

- Features:
 - Bromine/Iodine/Oxygen gas added to bulb
 - Small, high temperature glass envelope on bulb
- Yields a filament recycling process

Three-Way Bulb

- Two separate filaments
 - One low-power filament
 - One high-power filament
- Three light levels
 - Low-power filament only
 - High-power filament only
 - Both filaments together

Specialized bulbs

- Clear vs. Soft white bulbs
- Long life (high voltage) bulbs
- Rough service bulbs
- Energy-saver bulbs
- Krypton bulbs
- Heat bulbs
- Photoflood bulbs