Thermodynamics of Energy Conversion and Storage

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EXERCISES 11

1) What measurement can you do to distinguish between a metal, semiconductor and a insulator?

Conductivity as a function of temperature:
metal: high and decreasing with increasing temperature
semiconductor: low and increasing with increasing temperature
insulater: very low, and no change with temperature

2) What energy corresponds to a visible photon?

visible spectrum: 400 - 800 nm
$E = h \cdot \nu = h \cdot c/\lambda$
$E\ (400nm) = 6.626 \cdot 10^{-34} \cdot 3 \cdot 10^{8} m/s / 4 \cdot 10^{-7} m / 1.60218 \cdot 10^{-19} eV/J = 3.1\ eV$
$E\ (800nm) = 6.626 \cdot 10^{-34} \cdot 3 \cdot 10^{8} m/s / 8 \cdot 10^{-7} m / 1.60218 \cdot 10^{-19} eV/J = 1.55\ eV$

3) Calculate the size of the PV in order to cover the electricity demand for a house (2 kW).

Electricity demand = 17'520 kWh/year
Surface area 17'520 kWh/year/ 100 $kWh/m^2/year = 175\ m^2$

4) Calculate the estimated growth rate per year for the installed peak power of PV.

Growth is approximately factor of 10 times in 5 years = factor of 1.6 per year

5) Calculate the surface area of PV necessary to cover the world energy consumption.

$18 \cdot 24 \cdot 365$ TWh/year/100 $kWh/m^2/year = 1.6 \cdot 10^{12}\ m^2 = 1.6 \cdot 10^{6}\ km^2$