Polarization of the Incandescence Light Emitted by Thin, Hot Tungsten and Cobalt Wires

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We measured the degree of polarization P of the light emitted in the wavelength range 1 to 12 micron from thin tungsten and cobalt wires heated from a little above room temperature up to melting. The wire diameters are 9, 25, and 50 micron. For all samples the emitted light is partially polarized perpendicularly to the wire axis. P varies from roughly 30% at relatively low temperature (T~500 K) for both materials down to 17% for tungsten at melting (T~3700 K) and to 7% for cobalt at melting (T~1770 K). For tungsten the variation of P with T is smooth. Its behavior can quite satisfactorily be reproduced by the theory of scattering of electromagnetic waves off a cylindrical metal object in spite of the great uncertainties of literature data on tungsten emissivity and provided that an accurate extrapolation is carried out of the Drude parameters for the tungsten dielectric constant, which are given in literature only for a limited wavelength (<2.65 micron) and temperature (<2400 K) range. For cobalt the transition from high- to low polarization degree is sharper than in tungsten. It apparently takes place in a temperature range between the structural hip->fcc martensitic transition (~670 K) and the ferro-paramagnetic Curie transition (~1400 K.) The observed variation of P with T also shows a hysteretic behavior. As no data on the temperature and wavelength dependence of the dielectric constant of cobalt are available in literature for the wide ranges we explored, we have not been able to compute the prediction of the electromagnetic scattering theory. Thus, the cobalt data are the first measurements of this kind and still deserve to be fully rationalized.