After several years of uncertainty, it emerged that plasma-deposited amorphous silicon contained a significant percentage of hydrogen atoms bonded into the amorphous silicon structure and that these hydrogen atoms were essential to the improvement of the electronic properties of the plasma-deposited material [9]. As a consequence, the improved form of amorphous silicon has generally been known as *hydrogenated amorphous silicon* (or, more briefly, a-Si:H). In recent years, many authors have used the term *amorphous silicon* to refer to the hydrogenated form, which acknowledges that the unhydrogenated forms of amorphous silicon are only infrequently studied today.

Why was there so much excitement about the amorphous silicon solar cells fabricated by Carlson and Wronski? First, the technology involved is relatively simple and inexpensive compared to the technologies for growing crystals. Additionally, the optical properties of amorphous silicon are very promising for collecting solar energy, as we now explain. In Figure 12.2, the upper panel shows the spectrum for the optical absorption coefficients $\alpha(h\nu)$ for amorphous silicon and for crystalline silicon [10].[2] In the lower panel of the figure, we show the spectrum of the "integrated solar irradiance;" this is the intensity (in W/m^2) of the solar energy carried by photons above an energy threshold $h\nu$ [11].

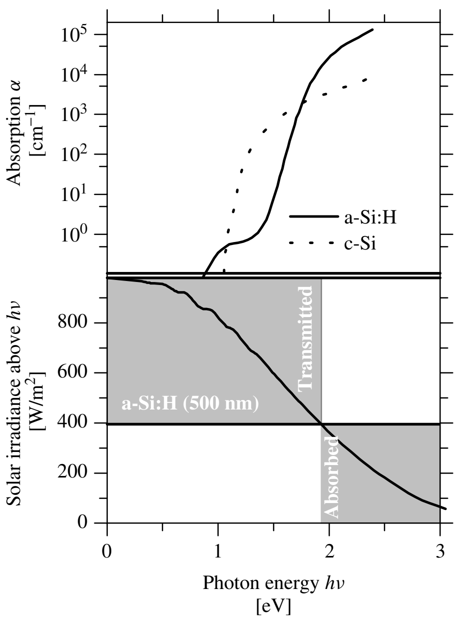

Figure 12.2 (Upper panel) Spectra of the optical absorption coefficient $\alpha(h\nu)$ as a function of photon energy $h\nu$ for crystalline silicon (c-Si) and for hydrogenated amorphous silicon (a-Si:H). (Lower panel) The solid curve indicates the irradiance of photons in the solar spectrum with energies $h\nu$ or larger. An a-Si:H film that is 500 nm thick mostly absorbs photons above 1.9 eV; as indicated by the shaded areas, this corresponds to an absorbed irradiance of about 390 W/m^2. After Vaněček M *et al.*, *J. Non-Cryst. Solids* **227–230**, 967 (1998) [10]

[2] We assume familiarity with the concept of a photon energy $h\nu$ and of an optical absorption coefficient α; see Chapter 3.