In Dundee, Scotland, Walter Spear and Peter LeComber discovered around 1973 that amorphous silicon prepared using a "glow discharge" in silane (SiH_4) gas had unusually good electronic properties; they were building on earlier work by Chittick, Sterling, and Alexander [3]. Glow discharges are the basis for the familiar "neon" light; under certain conditions, an electric voltage applied across a gas can induce a significant electrical current through the gas, and the molecules of the gas often emit light when excited by the current. Amorphous silicon was deposited as a thin film on substrates inserted into the silane gas discharge.[1] Spear and LeComber reported in 1975 [4] that amorphous silicon's conductivity could be increased enormously either by mixing some phosphine (PH_3) gas or some diborane (B_2H_6) gas with the silane. Just as for crystal silicon, the phosphorus doping of the amorphous silicon had induced a conductivity associated with mobile electrons (the material was "n-type"), and the boron doping had induced a conductivity associated with mobile holes (the material was "p-type").

In 1974, at the Radio Corporation of America (RCA) Research Laboratory in Princeton, David Carlson discovered that he could make fairly efficient solar cells using a silane glow discharge to deposit films. In 1976, he and Christopher Wronski reported a solar cell based on amorphous silicon [5] with a solar conversion efficiency of about 2.4% (for historical discussion see Reference [6, 7]).

Carlson and Wronski's report of the current density versus output voltage is presented in Figure 12.1 (along with the curve from a far more efficient cell reported in 1997 [8]). As these scientists had discovered, the optoelectronic properties of amorphous silicon made by glow discharge (or "plasma deposition") are very much superior to the amorphous silicon thin films prepared, for example, by simply evaporating silicon.

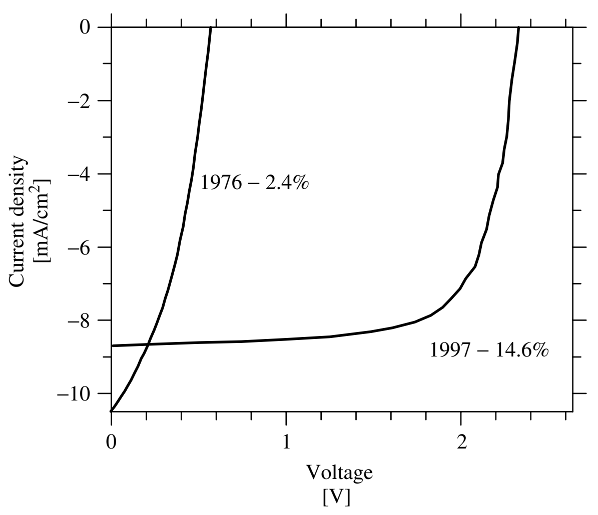

Figure 12.1 Current density versus voltage under solar illumination for a very early single-junction amorphous silicon solar cell (Carlson and Wronski [5]) and from a recent "triple-junction" cell (Yang, Banerjee, and Guha [8]). The stabilized efficiency of the triple-junction cell is 13.0%; the active area is 0.25 cm^2

[1] The term *amorphous* is commonly applied to noncrystalline materials prepared by deposition from gases.