12.3.3.1 VHF glow discharge deposition

The group at Université de Neuchatel [65, 83] has pioneered VHF plasma as a route to higher deposition rates. Figure 12.12 shows a linear increase in the deposition rate of a-Si films as a function of plasma excitation frequency (under constant plasma power). One key to the success of this approach is that higher excitation frequency enables researchers to deposit a-Si films at rates exceeding 10 Å/s, without making polyhydride powder, as is found when deposition rates are increased by increasing RF power at a lower frequency.

The exact reasons for the high-rate, powder-free deposition of a-Si using a VHF plasma are not well understood. At this moment, it is thought that the beneficial effect is due to an enhancement in the high-energy tails of the electron energy distribution function of the plasma [66, 84].

High-quality films and devices have been obtained using VHF deposition [66, 83, 85]. Table 12.3 compares four single-junction solar cells with intrinsic layers fabricated using low and high frequencies and low and high RF power; otherwise the deposition conditions were identical. While for low-power deposition the cell performances are similar, at high deposition rate, the VHF-produced devices are superior

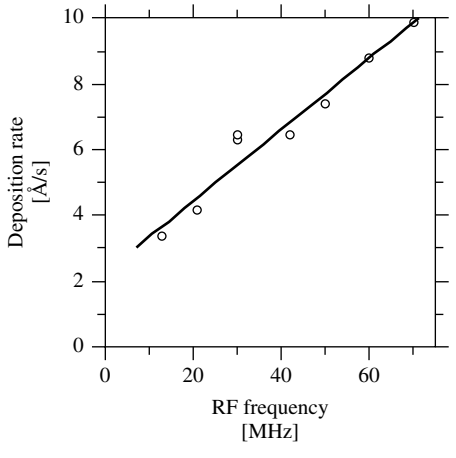

Figure 12.12 Deposition rate for a-Si:H films as a function of RF excitation frequency (at constant power); (After Shah A *et al*., *Mater. Res. Soc. Symp. Proc.* **258**, 15 (1992) [83])

Table 12.3 Comparison of solar cell properties for cells with *i*-layers deposited using RF and VHF frequencies and different deposition rates. The VHF-deposited devices are superior at high deposition rate [85]

Excitation frequency [MHz]	Deposition rate [Å/s]	Initial cell power [mW/cm^2]	Degradation [%]
RF (13.56)	0.6	6.6	14
VHF (70)	10	6.5	10
RF (13.56)	16	5.3	36
VHF (70)	25	6.0	22