

**Table 1.2** Notable events in the history of photovoltaics

- 1839 Becquerel (FR) discovered photogalvanic effect in liquid electrolytes
- 1873 Smith (UK) discovered photoconductivity of solid Se
- 1877 Adams and Day (UK) discover photogeneration of current in Se tubes; the first observation of PV effect in solids
- 1883 Fritts (US) makes first large area solar cell using Se film
- 1954 First 6% efficient solar cells reported: Si (Bell Lab, USA) and  $\text{Cu}_2\text{S}/\text{CdS}$  (Air Force, USA)
- 1955 Hoffman Electronics (USA) offers 2% efficient Si PV cells at \$1500/W
- 1958 NASA Vanguard satellite with Si backup solar array
- 1959 Hoffman Electronics (USA) offers 10% efficient Si PV cells
- 1963 Sharp Corp (JP) produces first commercial Si modules
- 1966 NASA Orbiting Astronomical Observatory launched with 1 kW array
- 1970 First GaAs heterostructure solar cells by Alferov, Andreev *et al.* in the USSR
- 1972 First PV conference to include a session on terrestrial applications (IEEE)
- 1973 A big year in photovoltaics: Worldwide oil crisis spurs many nations to consider renewable energy including photovoltaics; Cherry Hill Conference in USA (established photovoltaics' potential and legitimacy for government research funding); World's first solar powered residence (University of Delaware, USA) built with  $\text{Cu}_2\text{S}$  (not c-Si!) solar modules
- 1974 Project Sunshine initiated in Japan to foster growth of PV industry and applications; Tyco (USA) grows 2.5 cm wide Si ribbon for photovoltaics, first alternative to Si wafers
- 1975 First book dedicated to PV science and technology by Hovel (USA)
- 1980 First thin-film solar cell >10% using  $\text{Cu}_2\text{S}/\text{CdS}$  (USA)
- 1981 350 kW Concentrator array installed in Saudi Arabia
- 1982 First 1 MW utility scale PV power plant (CA, USA) with Arco Si modules on 2-axis trackers
- 1984 6 MW array installed in Carrisa Plains CA, USA [35]
- 1985 A big year for high-efficiency Si solar cells: Si solar cell >20% under standard sunlight (UNSW, Australia) [36] and >25% under 200X concentration (Stanford Univ. USA) [37]
- 1986 First commercial thin-film power module, the a-Si G4000 from Arco Solar (USA)
- 1987 Fourteen solar powered cars complete the 3200 km World Solar Challenge race (Australia) with the winner averaging 70 kph
- 1994 GaInP/GaAs 2-terminal concentrator multijunction >30% (NREL, USA) [38]
- 1995 "1000 roofs" German demonstration project to install photovoltaics on houses, which triggered the present favorable PV legislation in Germany, Japan and other countries
- 1996 Photoelectrochemical "dye-sensitized" solid/liquid cell achieves 11% (EPFL, Switzerland) [39]
- 1997 Worldwide PV production reaches 100 MW per year
- 1998  $\text{Cu}(\text{InGa})\text{Se}_2$  thin-film solar cell reaches 19% efficiency (NREL, US) [40] comparable with multicrystalline Si. First concentrating array for space launched on Deep Space 1 by US (5 kW using high efficiency GaInP/GaAs/Ge triple junction cells)
- 1999 Cumulative worldwide installed photovoltaics reaches 1000 MW
- 2000 Olympics in Australia highlight wide range of PV applications, and the awarding of the first Bachelor of Engineering degrees in Photovoltaics and Solar Engineering (UNSW, Australia)
- 2002 Cumulative worldwide installed photovoltaics reaches 2000 MW. It took 25 years to reach the first 1000 MW and only 3 years to double it; production of crystalline Si cells exceeds 100 MW per year at Sharp Corp. (Japan). BP Solar ceases R&D and production of a-Si and CdTe thin-film modules in USA ending >20 years of effort