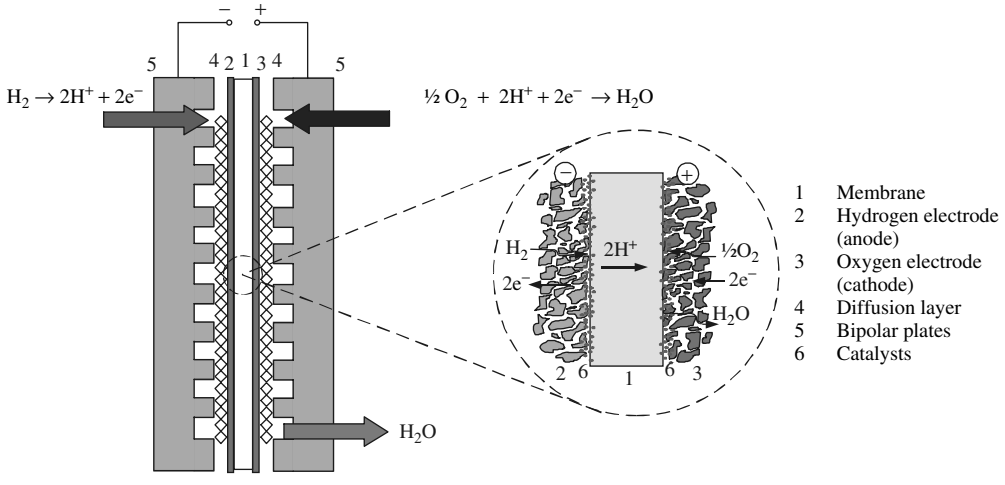

Figure 18.29 Schematic of a polymer electrolyte membrane fuel cell (PEMFC)

The current/voltage characteristic of a fuel cell is quite similar to the characteristic of a PV cell. Unlike secondary electrochemical batteries, the voltage depends very much on the current. To supply a load with a constant voltage, power electronics are necessary. The power electronics are also needed to adjust the point on the I/V curve corresponding to the actual power demand. Therefore, the operation of a fuel cell in applications with varying load demands without power electronics is impossible. Charging of a battery with a fuel cell is in principle possible. However, the fuel cell must not exceed certain current limits for a safe operation. Power electronics that limit current and voltage according to the requirements are highly recommended. Power electronics are necessary in any case if a controlled charge of a battery according to one of the charging regimes given in Figure 18.23 is necessary.

Presently, no cost figures for marketable fuel cells can be given as all available PEM fuel cells are prototypes for R&D and demonstration. However, there is a huge bunch of activities in fuel cell research. They are mainly driven by the automobile industry and by the combined heat and power generation CHP space-heating applications. The target figures for fuel cell systems in these applications are approximately 100 euro/kW for automobiles and 1000 euro/kW for CHP space-heating systems.

18.5.2.4 Applications

Hydrogen storage systems have a low overall efficiency. Even under the assumption of a fuel cell system efficiency of 50%, an electrolyser system efficiency of 85%, no energy losses for the hydrogen storage and efficiencies of 97% each for the two power-converting steps, an overall storage system efficiency of 40% maximum is achievable. Compared with approximately 90% efficiency in lead acid or lithium batteries, this is rather small and rules out the hydrogen system as the principle and only energy storage unit in autonomous power supply systems. This will be the fact as long as the power production is as expensive as it is now. Secondly, the specific storage costs per kilowatt