Figure 18.11 A battery in a photovoltaic system with a rated capacity of $C_{10} = 37.5$ Ah and a rated voltage of 168 V (flat-plate technology, 28 blocks of 6 V connected in series, Picture courtesy Fraunhofer ISE)

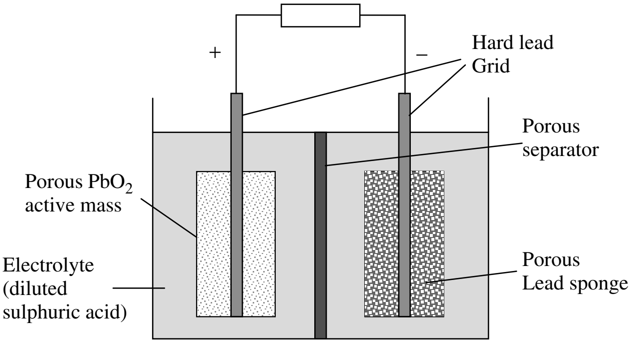

Figure 18.12 Schematic construction of a $Pb/H_2SO_4/PbO_2$ cell

PbO_2 (lead dioxide) for the positive electrode and to the Pb sponge for the negative electrode. Figure 18.13 shows a more detailed view of the structure of the active material. The active material has an internal surface area of approximately 0.5 to 5 m^2/g for the negative and the positive electrode in the fully charged state. The reaction speed and thus the charging and discharging properties are determined by the internal surface. Both electrodes are completely immersed in diluted sulphuric acid (H_2SO_4). As described earlier, the sulphuric acid plays a double role as the ion conductor between the electrodes and a reagent in the charge and discharge reactions. While the battery discharges, the PbO_2 and Pb are converted to $PbSO_4$ (lead sulphate). The sulphate ions (SO_4^{2-}) are drawn from the electrolyte, causing the electrolyte concentration to fall.

It is worth mentioning that the ratio of the specific volumes of $PbSO_4$ and Pb is 2.4 and the ratio between $PbSO_4$ and PbO_2 is 1.96. This means that the solid-phase volume of the active materials increases during discharge. This reduces the free electrolyte volume in the pores and causes mechanical stress on the active material.