Although oxygen residing on interstitial lattice sites is not electrically active, recombination-active oxygen complexes such as thermal donors [20–22], new donors [23, 24] and oxygen precipitates may be formed after annealing steps, specifically in the high oxygen concentration bottom part of the ingot (see an example of the donor activity in Figure 6.11).

Specifically, thermal donors turned out to be mainly responsible for a broad low-lifetime region with a width of 4 to 5 cm in the bottom part of Bridgman-type ingots [25]. Owing to the instability of the thermal donors in high-temperature steps during solar cell processing, these low lifetimes, however, does not lead to low efficiencies. It is worth noting that the width of this low-lifetime region in the bottom part of the ingots is largely reduced for material from the block-casting process. The most likely explanation for this is the shorter process times that consequently give less time for the formation of oxygen complexes out of interstitial oxygen atoms.

Similar to metals, oxygen segregation at grain boundaries and dislocations enhances the recombination strength of these extended defects. Oxygen precipitates may also getter metal impurities during crystallisation, which are released afterwards during solar cell processing as highly recombination-active point defects.

Generally, the manifold involvement of oxygen in efficiency-relevant microscopic processes makes the reduction of the oxygen incorporation into multicrystalline silicon one of the most important targets of material improvement efforts.

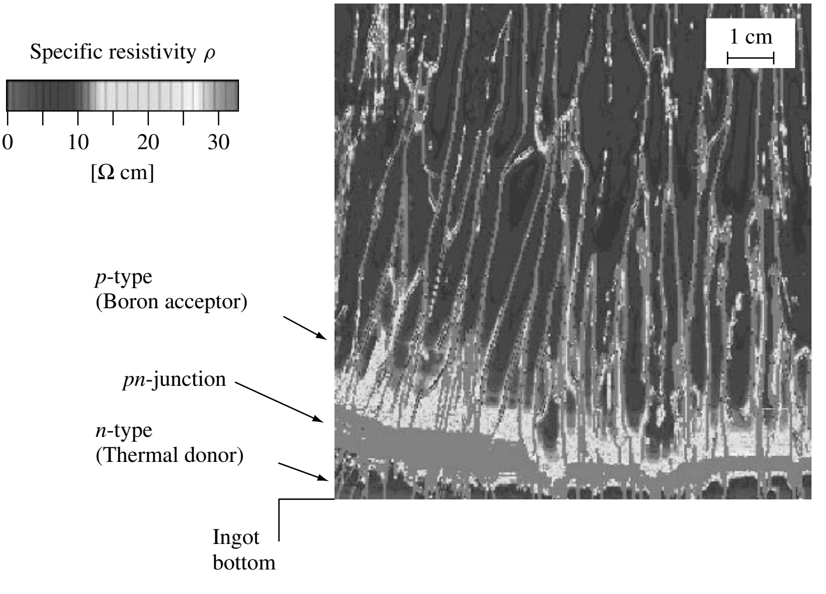

Figure 6.11 High resolution map of the specific resistivity (van-der-Pouw measurement technique) of a vertically cut wafer from a special high resistivity *p*-type multicrystalline silicon test ingot. Owing to the increased oxygen content, the formation of thermal oxygen donors changes the conductivity to *n*-type in the bottom part. The *pn*-junction can be identified by a remarkable increase in the specific resistivity