a low contact resistance to Si. Laboratory cells use photolithography and evaporation to form 10- to 15-μm metal fingers. Ti/Pd/Ag structures combine low contact resistance to *n*-Si and high bulk conductivity. These processes are not well suited to mass production that relies on thick-film technologies. Ag pastes are screen printed, resulting in over 100-μm wide lines with higher bulk and contact resistance. Laser-grooved buried-grid (LGBG) industrial cells implement a finer metallization technology [50], which will be presented in Section 7.7.3.

Coarser metallization techniques imply higher shading and resistance losses, and restrict the efficiency enhancement that could be achieved by internal cell design.

7.3.3.2 Homogeneous emitters

Under the metal lines, the substrate must be heavily doped to make the contact selective. Usually the doped region, the emitter, extends all across the front surface, acting as a "transparent electrode" by offering minority carriers in the substrate a low resistance path to the metal lines.

When the exposed surface is not passivated (Figure 7.3a), the emitter should be as thin as possible, because the high SRV makes the light absorbed in this region poorly collected, and also highly doped to decrease recombination. On the other hand, a sufficient low-sheet resistance is to be achieved. The solution is to make very thin and highly doped emitters.

If the surface is passivated (Figure 7.3b), the collection efficiency of the emitter can be raised by lowering the doping level thus avoiding heavy doping and other detrimental

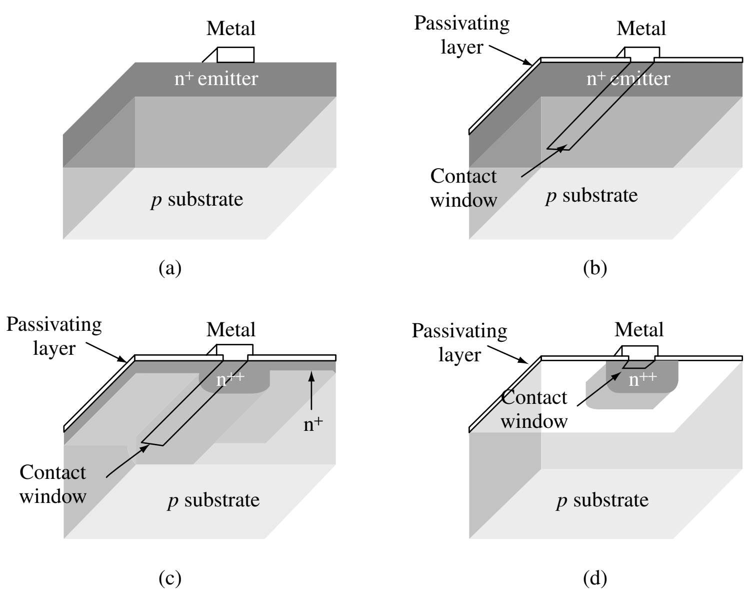

Figure 7.3 Different emitter structures: (a) homogenous emitter without surface passivation; (b) homogenous emitter with surface passivation; (c) selective emitter; and (d) localized emitter