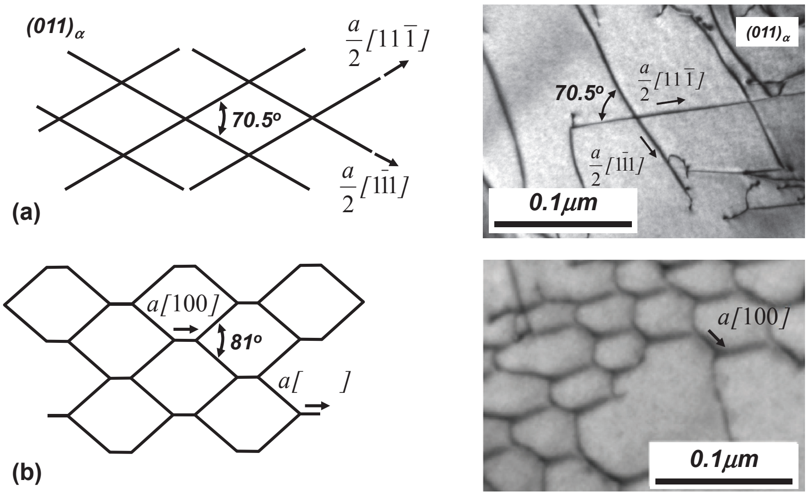

Fig. 3.21 Junction formation in a ferritic ultralow-carbon (ULC) steel after a tensile deformation of 4%. (a) Screw dislocations in their $\{110\}_\alpha$ type slip plane. (b) a<100> dislocation junctions formed in a coplanar screw dislocation array. Note that the screw segments connecting the junctions are not in their original position, i.e., parallel to $<111>_\alpha$-type directions. This is due to the orientation dependence of the elastic energy of the dislocation line.

In f.c.c. austenitic alloys, Lomer-Cottrell dislocation locks are formed by the reaction of two Shockley partial dislocations that glide on intersecting $\{111\}_\gamma$ planes and meet at the intersection of their slip planes, as shown in Fig. 3.22:

$$\delta B + B\alpha \rightarrow \delta\alpha = \frac{1}{2}AD$$

$$\frac{a}{6}[\bar{2}11] + \frac{a}{6}[1\bar{1}\bar{2}] \rightarrow \frac{a}{6}[\bar{1}0\bar{1}]$$

(Eq. 3.41)

The reaction is energetically favorable as:

$$\frac{6}{36}\cdot a^2 + \frac{6}{36}\cdot a^2 = \frac{1}{3}\cdot a^2 > \frac{2}{36}\cdot a^2 = \frac{1}{18}\cdot a^2$$

(Eq. 3.42)

The dislocation lies parallel to the line of intersection of the slip planes and has a pure edge character in the (100) plane. It is sessile because its Burgers vector does not lie in the ABC or BCD planes.

Another example of a sessile dislocation in austenitic steel is the Frank partial dislocation. It is an edge-type dislocation with an $a/3<111>_\gamma$-type Burgers vector. Frank partials cannot move by gliding, but by climbing. Small Frank partial dislocation loops can be formed by the agglomeration of vacancies or interstitials between two $\{111\}_\gamma$ planes. The normal f.c.c. stacking sequence is also disturbed by the presence of a Frank dislocation.

