In this chapter, the microstructure and properties of low carbon steel produced by TSCR (Thin Slab Casting and Rolling) technology are studied, and compared with that of traditional process. The microstructure refinement and austenite recrystallization of low carbon steel produced by TSCR technology are presented. The characteristic and the mechanism of AlN precipitation in the steel are discussed based experimental results. The dynamics and corresponding model of precipitation during the heating and rolling are discussed also. The influences of AlN particles on the precipitation action in austenite region and on the ferrite transformation are analyzed. In addition, the softening mechanisms of low carbon steel for cold rolling by TSCR are explained. These include the property requirements of cold-rolled drawing sheets to hot strip, softening methods, grain coursing and softening mechanisms of B added low-carbon steel, the effects of the hot rolling and cooling technology on the softening of low carbon steel as well as the influences of different softening technology on the formability of cold-rolled 08Al steels. On the other hand, the sulfide and oxide dispersive precipitates, other nanometer precipitates in the CSP low carbon steels, the carbides and carbonitrides in Ti containing steels, are introduced also in this chapter.

4.1 Microstructure Refinement Process and Austenite Recrystallization of Low Carbon Steels Produced by TSCR Technology

4.1.1 Contrast between TSCR technology and traditional technology

In the past few years, the processes used to control the rolling and cooling
process continuously changes with the improvement in the technology of in the entire TSCR production line. Compared with the traditional technology, TSCR is similar in controlling of rolling and cooling process. However, it shows a special technology character and advantage by a systematic combination with the whole compact production line.

![Figure 4.1 Disposal sketch of CSP equipment](image)

More than 40 TSCR production lines have been built all over the world until 2006, CSP production lines count about 2/3 of those, while the others are FTSR, QSP, CONROLL, and so on. In CSP production line, the equipment is relatively simple, and the technological process is smooth. Besides, the production of CSP technology is very stable, and this technology is very perfect. The sketch of CSP equipment is shown in Figure 4.1. The thickness of casting thin slab in CSP line is usually between 50 and 70mm (when using dynamic soft reduction system, the thickness of casting slab, which is 90mm after mould, can be reduced to 65~70mm with the liquid core, or from 70mm to 55mm). The finishing mill group contains about 6~7 stands. Since the TSCR has its special technological constitution and characters, it is different from the traditional technology in the main segments, such as casting, rolling, and so on. The characters in rolling process of both the two technologies will be introduced as follows.

TSCR process is different from the traditional continuous casting and rolling mostly in the thermal histories. The contrast between them is shown in Figure 4.2. In TSCR process, from the smelting to the final strips, the slab experience a nonreversing phase transformation of $\gamma \rightarrow \alpha$ and from high to low temperature. However, in traditional process the thermal history of the slab is $\gamma_{(1)} \rightarrow \alpha$, $\alpha \rightarrow \gamma_{(2)}$, $\gamma_{(2)} \rightarrow \alpha$. Since the thermal histories, forming conditions and processes are different during continuous casting and rolling of thick and thin slabs, the conditions are different which determine recrystallization, phase transformation and the precipitates, including the precipitation process, status and factors. It takes about 2.5h for the liquid steel to be slabs in TSCR procedure, while the time is much longer in traditional ones. This will cause different influences on the microstructure and properties (KangYL et al, 2005).

At present, the key technique of CSP, continuous passing roller-hearth furnace is usually used to soak the slab, while laminar accelerate cooling system is used to cool the final strip. In CSP technology, the rollers are disposed in a different