Study on recrystallization behavior of the cold rolled 12Cr ODS steel  
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Abstract  
The recrystallization behavior of cold rolled 12Cr ODS steel with 60%-90% thickness reductions under 800-1100°C annealing was investigated by SEM, EBSD, TEM and hardness testing. Results show that recrystallization and fewer voids were achieved at lower than 1100°C. Partial recrystallization occurred at 800°C and 900°C, whereas, abnormal grain growth was observed at higher temperatures.  
Keywords: Oxide dispersion strengthened steels, cold rolling, recrystallization, abnormal grain growth

1. Introduction  
Oxide dispersion strengthened (ODS) steels have been developed as one of prospective candidate materials for fast reactor cladding as well as fusion reactor blanket applications. Mechanical alloying and then consolidation by hot isostatic pressing and/or hot extrusion are frequently implemented in the fabrication of ODS steels. These features introduce strong anisotropy in mechanical properties as well as high hardness, low ductility. The recrystallization process has been regarded as an approach to overcome this hurdle for ODS ferritic steels. However, the recrystallization temperature is so extremely high that porosity would be developed in the previous study [1], which has a detrimental effect on mechanical properties, such as loss of strength and ductility, and acceleration of creep fracture process. Aiming to obtain recrystallization and avoid porosity formation, cold rolling and its influence on the microstructural evolution during lower temperature annealing will be investigated.

2. Experimental procedure  
The 12Cr ODS steel with a nominal composition Fe-12Cr-2W-0.3Ti-0.25Y₂O₃ (in wt. %) was fabricated by KOBELCO. The specimens with a thickness of 3 mm were cut through original transverse direction (TD) from the as-received plate, and then cold rolling was conducted on the original normal direction (ND)-TD plane several cycles with thickness reductions of 60%, 75% and 90% by a laboratory rolling mill. Afterwards, the cold-rolled plates were cut into small pieces for the subsequent heat treatment, which was isothermal annealing in the range 800-1100°C for 3 h in the vacuum furnace. Microstructure and crystallographic texture of specimens were characterized by field-emission scanning electron microscope (SEM) equipped with an electron backscatter diffraction (EBSD) device. The specimens were also examined by transmission electron microscope (TEM).

3. Results  
Cold rolling induced γ-fiber ([111]//ND) texture promoted recrystallization, which was achieved with fewer voids at lower than 1100°C. Partial recrystallization and abnormal grain growth were dependent on the annealing temperature and thickness reduction, which will be discussed in detail.

References  