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The investigation of step structure with different TSDs conversion behavior during 4H-SiC solution growth

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Introduction: Solution growth of SiC attracts great attention because of its potential to achieve high-quality crystal. We have reported high quality SiC growth on the Si face due to the conversion of threading screw dislocations (TSDs) to stacking faults (SFs) which rarely happened on C face [1-2]. In our recent research, the TSDs conversion behavior can be observed on the C face of grown crystal using Si-5%Ti solvent. The formation of macrosteps on the growth surface has considered to be attributed to the TSD conversion [3]. However, according to our results, not all the macrosteps can cause the conversion happen. Thus, we assumed the TSDs conversion is promoted not only by the step height but also the step shape. In this study, the detail of steps structure was investigated.

Experimental: Crystal was grown by top-seeded solution growth method using Si-5at%Ti solvent. 4H-SiC C-face with 2° off cut towards [1120] direction was used as a seed crystal. The growth was conducted at 1700 °C for 1 hour. Nomarski microscopy, X-ray topography and transmission electron microscopy (TEM) were performed to characterize the grown crystal.

Results and Discussion: Fig. 1 presents the cross-sectional TEM images of the macrostep structure which made the TSDs converted to SFs on the C face of grown crystal using Si-5%atTi solvent. High magnification TEM image of the macrostep facet is shown in the inset. Considering the interaction between the facet surface and TSDs which may result in TSDs conversion during step flow growth, the

various step shapes (including the step height and the angle between facet and basal plane) with different TSD conversion ratio are summarized in Table 1. According to Table 1, we deduce that by changing the step structure on grown crystal surface, the TSDs conversion behavior could be dominated.

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Step flow

Fig.1. Cross-sectional TEM images of the grown crystal using Si-5at%Ti solvent on the C face at low magnification. The inset shows high magnification TEM image of macrostep facet.

 Table 1. The comparison of step structure on different

 morphology & TSD conversion ratio

Solvent	Face	Angle between facet and basal plane	Step height	conversion ratio
Pure Si ^[3]	Si	30°	0.15µm	100%
	С	30°	0.002µm	0
Si-5at%Ti	С	15~20°	1~2µm	10%

Height: "1µm Height: "1µm 1 Cross sectional TEM images of the group