第76回応用物理学会秋季学術講演会 講演予稿集 (2015 名古屋国際会議場)

シリコン単結晶成長における転位密度低減に対する結晶成長方位の役割

Role of growth orientation in suppressing dislocation generation during single crystal growth of silicon

九大応力研，○高 冰，中野 智，原田 博文，宮村 佳児，柿本 浩一

RIAM, Kyushu Univ. ○B. Gao, S. Nakano, H. Harada, Y. Miyamura, K. Kakimoto

Email: gaobing@riam.kyushu-u.ac.jp

Introduction

To reduce dislocations during crystal growth of silicon, many attempts have been performed, such as combination of different orientated seeds, replacement of multi-seed by one-seed, control of grain boundaries, and control of impurities, and so on. All of them can more or less reduce some dislocations. In this paper, we want to study the possibility of suppressing the generation of dislocations by only changing the growth orientation, and determine which orientation is beneficial for reducing dislocations.

Results

To determine the influence of growth orientation on the generation of dislocations, we use our advanced 3D dislocation model to simulate a heating and cooling process on several single crystal ingots of silicon. The ingots have different growth orientations. After cooling to room temperature, the dislocation distributions for the [001], [110], [111], and [112] growth orientations are shown in Fig. 1. The maximum dislocation density on the surface of ingots for the [001], [110], [111], and [112] growth orientations is 7900, 17, 4300, and 8300 cm^{-2}, respectively. Thus, the [111] growth orientation can reduce the dislocation density by almost 50% compared to the [001] or [112] growth orientation, and the dislocation density for the [110] growth orientation is the lowest.

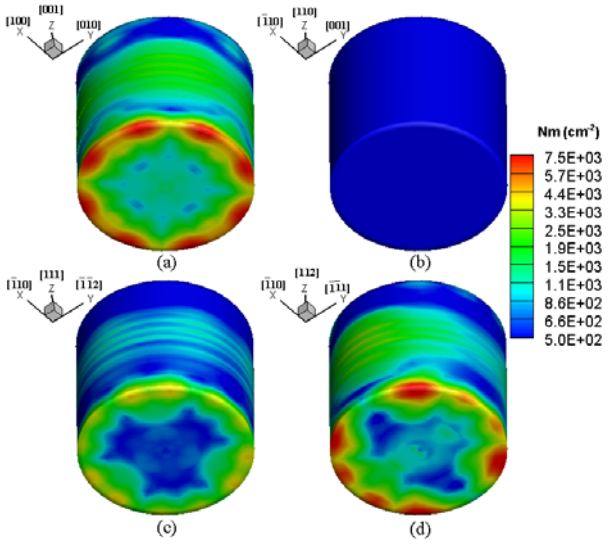

Fig. 1. Global distributions of dislocation density for the (a) [001] growth, (b) [110] growth, (c) [111] growth, and (d) [112] growth.

Acknowledgements

This work was partly supported by the New Energy and Industrial Technology Development Organization under the Ministry of Economy, Trade and Industry (METI).