POLAR-2D/A ; Simulation of Silicon Thermal Oxidation Using BFC (Boundary Fitted Coordinate System)

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INTRODUCTION

Recently, various simulator of thermal oxidation have been developed. It is important for a simulator of thermal oxidation to express the shape.

In this paper, the model using BFC, which has the good shaping expression, is introduced.

NUMERICAL MODEL

The oxidation model is based on the incompressible viscous fluid flow model[1] as follows.

The Diffusion of Oxidant / The Incompressible Viscous Fluid Flow

$\dot{C}_{ox}+\nabla\cdot(D_{ox}\nabla C_{ox})=0$ (1) $\dot{U}+\nabla P-\mu\nabla^2 U=0$ (2) , $\nabla\cdot U=0$ (3)

Here, the Viscous flow problem is solved by the MAC (Maker And Cell) method[2]. For a time integration and a space discretization, the RRK scheme[3] and the finite difference method are used, respectively.

BFC

BFC (Boundary Fitted Coordinate System) is how to solve a partial differential equation on the computational domain. The physical dommain (x,y) for analyzing is transformed onto the normal rectangular domain that is computational domain (ξ , η).

The grid generation on the physical domain is obtained by the solving the elliptic partial differential equations on the computational domain as follows[4].

$$aX_{\xi\xi}+bX_{\xi\eta}+cX_{\eta\eta}=-J^2(PX_\xi+QX_\eta) \quad (5) \qquad ,aZ_{\xi\xi}+bZ_{\xi\eta}+cZ_{\eta\eta}=-J^2(PZ_\xi+QZ_\eta) \quad (6)$$

Here the subscripts indicate a partial difference.

Accodringly, the basic equation system on the physical domain is transformed on the computational domain. For instance, eq.(1) is transformed onto the following equation.

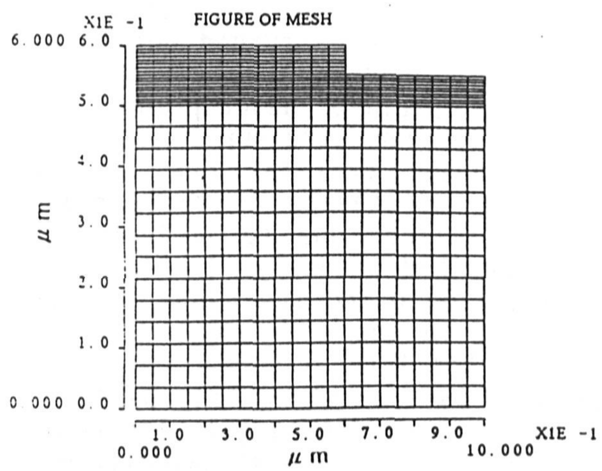
$$(JC_{ox})_t+(J\xi_t C_{ox})_\xi+(J\eta_t C_{ox})_\eta+(w^x\xi_x+w^y\xi_y)_\xi+(w^x\eta_x+w^y\eta_y)_\eta=0 \quad (1')$$

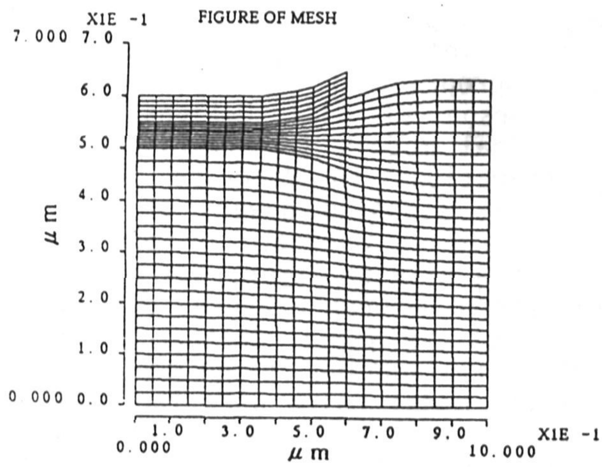
$$w^x=(J\xi_x C_{ox})_\xi+(J\eta_x C_{ox})_\eta \qquad ,w^y=(J\xi_y C_{ox})_\xi+(J\eta_y C_{ox})_\eta$$

CONCLUSION

Using this model, high accuracy oxidation shape can be obtained and the grid near the boundary is tuned.

Besides, impurity concentration and interstitial silicon in the 2-D process simulator "POLAR-2D/A" developed at present are dealt with similar to this paper .





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