

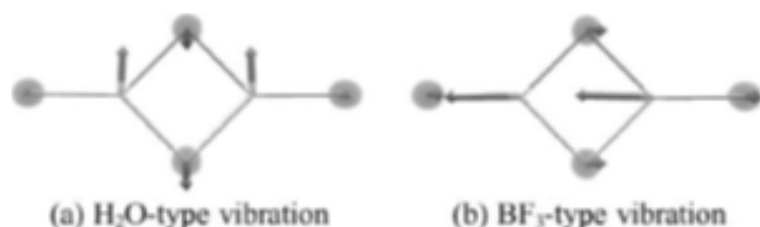
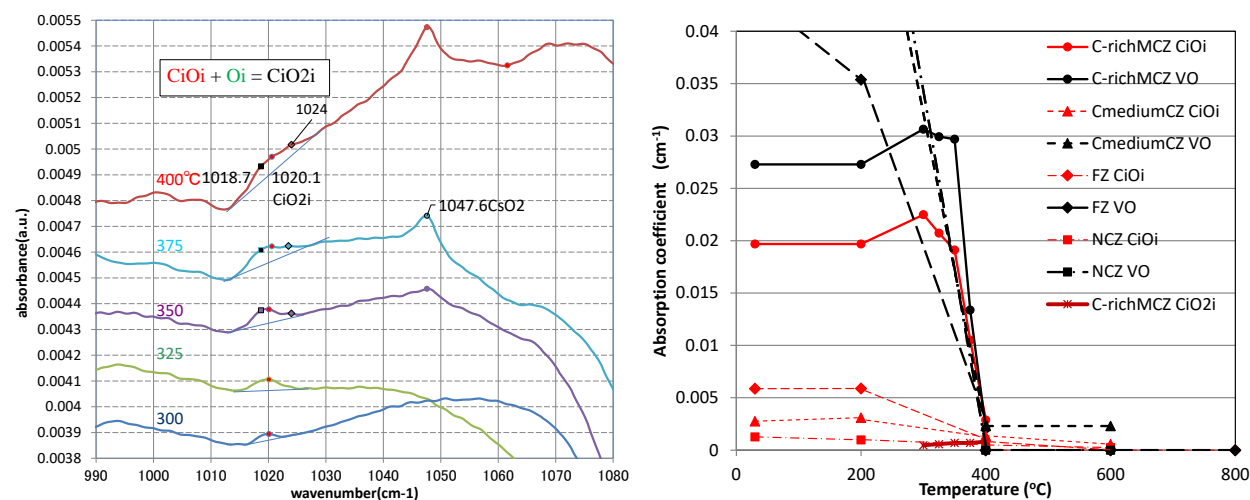
Quality of silicon substrate and point defects (5) C_iO_{2i} and NN, CO, NO, OO ringOsaka Pref. Univ.¹ $\circ\text{N. Inoue}^1$ S. Kawamata¹ and S. Okuda¹シリコン結晶基板の品質と点欠陥(5) C_iO_{2i} と正方形NN, CO, NO, OOリングの赤外吸収大阪府立大研究推進¹ \circ 井上直久¹, 川又修一¹, 奥田修一¹ E-mail: inouen@riast.osakafu-u.ac.jp

Introduction Nitrogen in silicon mainly forms $\text{Si-N}_i\text{-Si-N}_i$ (N_iN_i pair) ring (Fig. 1) [1]. Electron irradiation induced C_iO_i [2] which is used for the lifetime control in the power devices, NO forming shallow thermal donor (STD) [3], and OO (O_{2i}) forming the core structure of thermal double donor (TDD) [4], are the replacement of N_i in the same ring. Moreover these 4 members attract (and release reversely) the oxygen by the heat treatment at nearly equal temperature, and their local vibration modes (LVM) are infrared (IR) active. As all of them play important role in the defect formation, it is necessary to reveal their behavior. However, as their concentration is low, it is difficult to analyze as an individual. It is helpful that the information obtained on one member is readily transferred to the others. Here, the case of C_iO_{2i} whose IR peak has been observed recently at 1020 cm^{-1} is shown [5].

Experimental, result and discussion The C_iO_{2i} absorption at 1020 cm^{-1} in the electron irradiated and annealed CZ silicon samples was measured at RT with 2 cm^{-1} wavenumber resolution. Fig. 2 shows the temperature dependence of the IR spectrum and peak absorbance. Oxygen becomes active above $350\text{ }^\circ\text{C}$. In case of carbon concentration around $1 \times 10^{16}/\text{cm}^3$, parallel reactions occur and compete as, (1) $\text{C}_i\text{O}_i + \text{VO} = \text{C}_s\text{O}_2$, (2) $\text{C}_i\text{O}_i + \text{VO} = \text{C}_s\text{O} + \text{O}$, (3) $\text{VO} + \text{O} = \text{VO}_2$. Here, it is revealed that the following reaction takes place mainly above $400\text{ }^\circ\text{C}$ and competes with the above reaction (4) $\text{C}_i\text{O}_i + \text{O} = \text{C}_i\text{O}_{2i}$. At $400\text{ }^\circ\text{C}$, the C_iO_{2i} amount reaches about 1/5 of C_iO_i , and more above $400\text{ }^\circ\text{C}$. Therefore, it affects the concentration of C_iO_i . Moreover, C_iO_{2i} has the trap level and affects the lifetime [6]. The behavior in the less C samples must be examined. Collaboration and discussion with Prof. Londos is appreciated.

References

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Fig. 1 $\text{Si-N}_i\text{-Si-N}_i$ (N_iN_i pair) ring and LVM.Fig. 2 Left: IR spectrum of C_iO_{2i} after anneal. Right: Absorption coefficient of CO, CO_2 (thick brown at bottom) and VO.