

High sensitivity infrared absorption spectroscopy and infrared defect dynamics of
silicon crystal (18) Double peaks of nitrogen absorption
シリコン結晶の高感度赤外吸収と赤外欠陥動力学(18)窒素関連吸収の複ピーク

Osaka Pref. Univ.¹, °N. Inoue¹, S. Kawamata¹ and S. Okuda¹

大阪府大研究推進², °井上直久¹,川又修一¹,奥田修一¹

E-mail: inouen@riast.osakafu-u.ac.jp

Introduction The shape of infrared absorption peaks (IR) by the local vibration mode (LVM) of light impurity is Lorentzian usually. However, it was revealed that the 855 cm⁻¹ band from ONO shallow thermal donor (STD), the 689 cm⁻¹ band by VVNN introduced by the electron irradiation and annealing are rounded at the top [1], and the 551 cm⁻¹ band from N_i is extended on the higher wavenumber side [2]. We have recently revealed the latter is composed of the bands at 551 and 552 cm⁻¹ [3]. Here it is examined in detail.

Experiment, result and discussion IR absorption of nitrogen doped CZ and FZ silicon crystals was examined for the as-grown, irradiated and annealed states. The measurement was done at room temperature with wavenumber resolution of 2 cm⁻¹. Sensitivity was improved by various procedures. The 551 cm⁻¹ IR spectrum of various annealing temperatures is shown in the left figure. There is an additional band at 552 cm⁻¹ and the relative strength changes with the annealing temperature. In addition, there is another pair of bands at 556 and 557 cm⁻¹. The latter is strong at the middle temperature range and the former is strong at the low and high temperature ranges, showing the complementary annealing behavior. This strongly suggests the transformation between the former (N_i) and the latter (N_i+O?) configurations. The peak at 855 cm⁻¹ [4] from STD of (ONO)O_n [5] shown in the middle figure has the slope on the lower wavenumber side and accompanies the peak at 858 and 852 cm⁻¹. The apparent width of 689 cm⁻¹ band shown in the right figure is about 9 cm⁻¹. It accompanies the bands at 684, 677 and 674 cm⁻¹. Other nitrogen absorption bands also have complicated configuration.

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[1] Inoue, Kawamura, JAP, 123, 185701 (2018). [2] Inoue, Kawamata, Okuda, JSAP 2020S 15p-D411-4, [3] Ibid, Fall, 11p-Z12-16. [4] Inoue, SSP, 108-109, 609 (2005). [5] Fujita, Jones, Physica B, 401-402, 159 (2007).

