Trace Element Micro-Analysis by Transmission X-ray Microtomography using Absorption Edges

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Transmission X-ray microtomography (micro-CT) has been used to obtain 2- or 3-dimensional distribution of the linear absorption coefficient which is the product of the mass absorption coefficient and the density. When the components of the object are two or more elements, it is difficult to determine the density distribution of the specific element from the data obtained with only one particular X-ray energy.

We propose a new method which utilize two x-ray energies bellow and above the absorption edge of the specific element. We suppose that the linear absorption coefficient of a material at a particular X-ray energy can be written as the sum of the linear absorption coefficient of the specific element and the other total linear absorption coefficient of all the other elements. The latter value is derived by assuming that it is proportional to the X-ray energies bellow and above the absorption edge. In this paper, we show how to determine the density distribution of Fe and Ni in the synthetic diamond.

The experiments were carried out at the BL3C2 of the Photon Factory. The X-ray energies used were 6.4, 7.47, and 8.4keV which are appropriate for the examination of Fe and Ni. Transmission X-ray images were recorded with a CCD camera which has a fluorescence screen and an expansion optical lens (×10). Microtomographs of the $FeCl_2$ solution (1.6~0.005 mol/l) and the mixture of $FeCl_2$ (0.005~0.0625 mol/l) and $NiCl_2$ (0.4 mol/l) solutions were obtained to evaluate the new method. The density mapping of Fe and Ni in the synthetic diamond was carried out by making use of this method. The results are shown in Fig. 1 and Fig. 2. The arrows A and B indicate some inclusions.

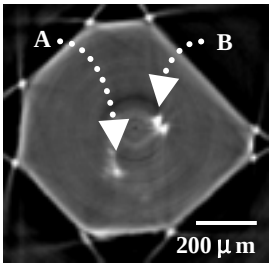

Fig. 1

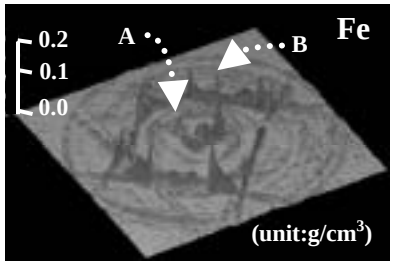

Fig. 2 (a)

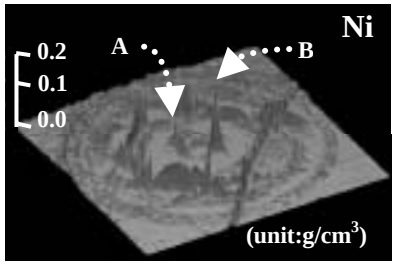

Fig. 2 (b)

Fig. 1 Reconstructed X-ray micro-CT image of the synthetic diamond

Fig. 2 The density distribution of Fe (a) and Ni (b)