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Determination of Dissolved Elements in Steel by Secondary Ion Mass Spectrometry

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In the process of the steel production, it is important to know the concentration of the element not only in the precipitates or inclusions but in the dissolved state. To know the concentration of the dissolved elements, we usually use the chemical analysis. In the procedure of chemical analysis, the matrix elements are dissolved by electrolytic dissociation and the residues collected are chemically analyzed. The concentration of dissolved elements are obtained by subtracting the amount of the element in the precipitates from the total amounts of the element in the initial specimen. When the concentration of the dissolved element is low, it may be difficult to determine the concentration of dissolved element because the total concentration and the concentration of precipitates becomes similar. In this article we show the method to determine the concentration of the dissolved elements.

When we intend to determine the concentration of dissolved element directly, we must know whether the element is in the state of precipitates or inclusions or not. And we must analyze the area where the element is in the dissolved state. We tried to use the secondary ion mass spectrometry (SIMS) because of its high sensitivity and high space resolution.

We used the SIMS apparatus of CAMECA IMS-5F. The following procedure was used. At first, we analyzed 500 x 500 micro meters region by scanning the incident oxygen beam of about 2 micro meters diameter. After that the depth profiling was done at the area where the secondary ion intensities were low. The depth profiling was done at more than five areas for each specimen. When there were precipitates or inclusions at the analyzed area, the secondary ion intensities rised considerably depending on the size or number of precipitates or inclusions.

We assumed that the minimum ion intensities indicated the concentration of dissolved elements. We compared these SIMS data with chemically determined data. When the concentration of the dissolved elements were more than 100 at. ppm, both data were farely consistent. However, when the concentration of dissolved element was lower, these data were not consistent. It suggests that in the case of chemical analysis, tiny precipitates or inclusions may be dissolved during the electrolytic extraction process.

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