Evaluation of Bonding States in Semiconductor Oxide Films

ION TECHNOLOGY CENTER

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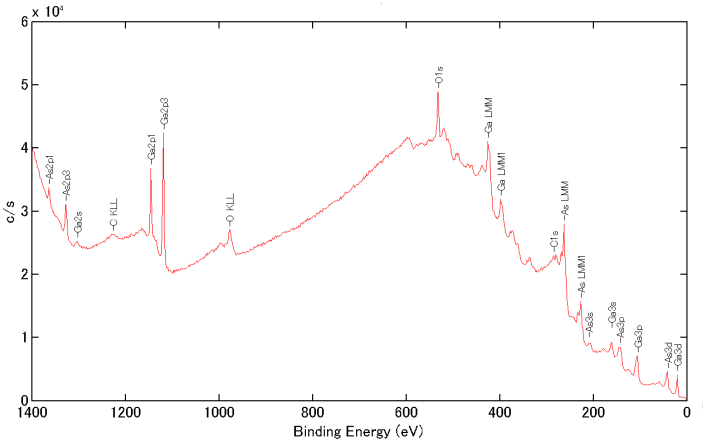
A native oxide film forms on the surface of a semiconductor substrate, and is widely recognized for its critical role in the structure and fabrication of semiconductor devices. In Silicon (Si), the most commonly used semiconductor material, the oxide film is silicon dioxide (SiO2) and stability is achieved by forming an oxide film of approximately 1nm thick.
In single-element materials such as Si, no significant differences are observed in the atomic structure of the oxidized region. However, an investigation was conducted to determine whether any structural differences exist in compound semiconductors, such as GaAs which is composed of two elements.

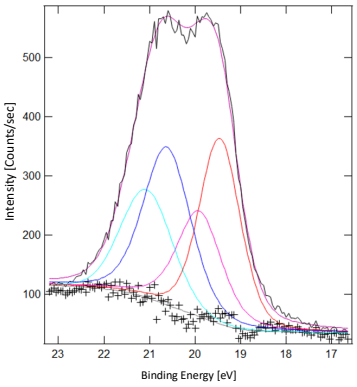
Elemental composition ratio (unit: atom%) of the sample surface was calculated by measuring the topmost surfaces of two GaAs substrates.

Sample	C1s	O1s	Ga3d	As3d
Sample-A	9.55	48.34	23.24	18.88
Sample-B	11.33	45.13	24.71	18.84

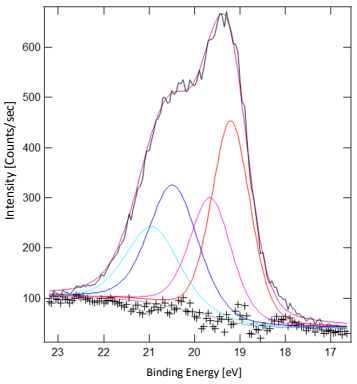


Survey Spectrum of GaAs Semiconductor Surface

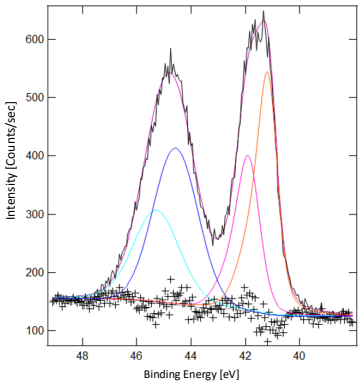
The result shows no significant differences between the samples. However, for a more detailed comparison, the bonding states of Ga and As atoms have been compared using spectral analysis. The analyzed peaks are Ga3d and As3d.



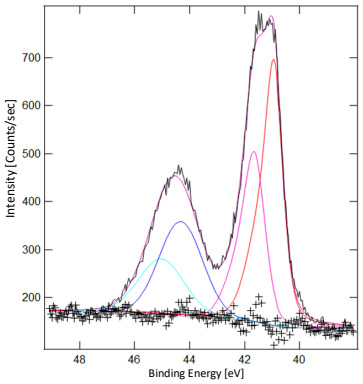
Ga3d (Sample A)



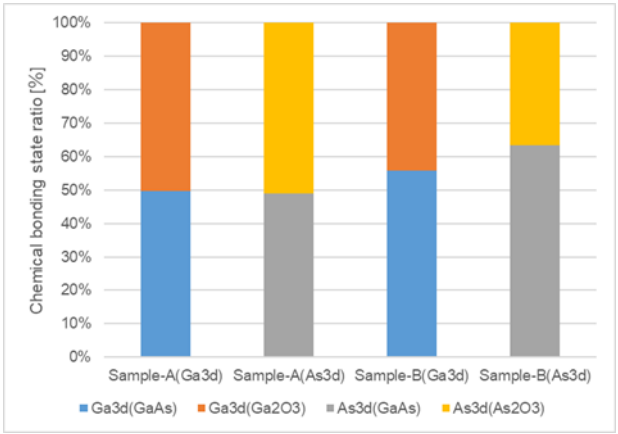
Ga3d (Sample B)



As3d (Sample A)



As3d (Sample B)



Bonding ratio of 2 samples

The following observations have been obtained from the curve fitting analysis:

- More oxides are present in Sample **A** than in **B**
- Although the oxide ratios of Ga and As are similar in Sample **A**, Sample **B** shows a tendency for greater Ga oxidation compared to As.

Thus, conducting a curve fitting analysis allows for clearer observation of sample differences, when no significant difference is evident with composition ratio alone.

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