

### Discussion

X-ray photoelectron spectroscopy (XPS, also known as Electron Spectroscopy for Chemical Analysis or ESCA) is a rapid and non-destructive method to characterize the surface chemistry of GaAs wafers. The surface sensitivity of XPS, which is typically 40-100 Å, makes the technique ideal for measurements of oxidation states and oxide layer thickness on III-V and other semiconductor materials.

The oxide characterization employs acquisition of high energy resolution spectra of Ga and As photoelectron peaks plus the application of mathematical curve separation routines as seen in figures 1 and 2. When combined with reference data, the relative percentages of species such as GaAs, Ga<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>3</sub>, and As<sub>2</sub>O<sub>5</sub> on the surface can be determined. This data can provide useful information on the surface stoichiometry and ratios of oxidized to non-oxidized species. The tables below are examples of measurements from two GaAs epi-ready wafers.

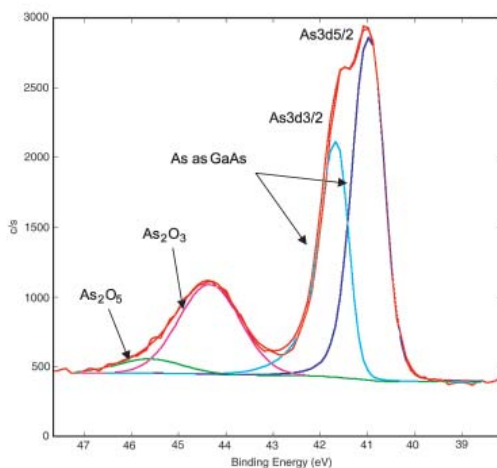


Figure 1.

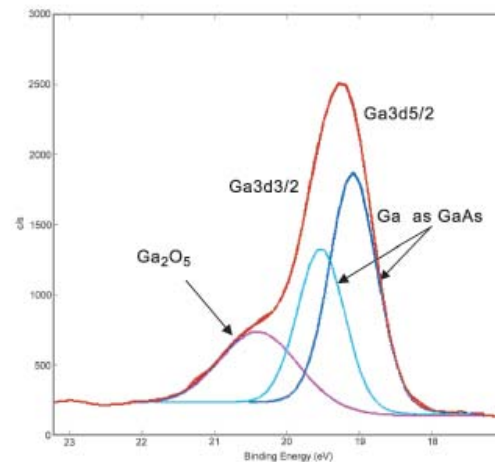


Figure 2.

Atomic Concentration Table (in at%)

|              | C    | O    | Ga   | As   |
|--------------|------|------|------|------|
| GaAs Wafer A | 19.4 | 24.6 | 30.3 | 25.7 |
| GaAs Wafer B | 17.7 | 29.3 | 29.0 | 24.0 |

Chemical Ratios and Comparisons of Ga and As

|              | Ga <sub>total</sub> /As <sub>total</sub> | Ga <sub>(GaAs)}</sub> /As <sub>(GaAs)}</sub> | Ga <sub>(ox)}</sub> /As <sub>(ox)}</sub> | Ga(GaAs)/Ga <sub>(ox)}</sub> | As <sub>(GaAs)}/As<sub>(ox)}</sub></sub> |
|--------------|--|--|--|------------------------------|--|
| GaAs Wafer A | 1.18                                     | 1.16   | 1.19                                     | 4.51                         | 4.59                                     |
| GaAs Wafer B | 1.21                                     | 1.29   | 0.97                                     | 4.13                         | 3.08                                     |

Note: Oxides in ratios include the sum of all oxides present for that sample, e.g. As<sub>ox}</sub> = As<sub>2</sub>O<sub>3</sub> + As<sub>2</sub>O<sub>5</sub>.

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