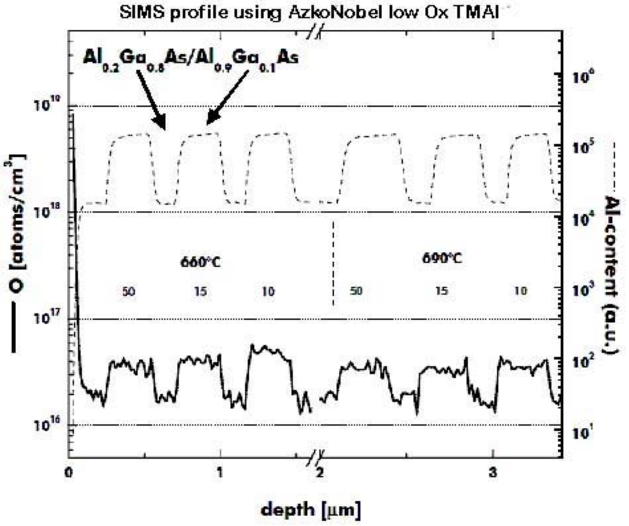
Low Ox TMAl

AkzoNobel High Purity Metalorganics (AkzoNobel HPMO) offers a Low-Ox grade of trimethylaluminum (TMAl) for use in III-V epitaxy by MOVPE. This offering has resulted from extensive R&D efforts and our ability to scale up this manufacturing process in order to consistently produce commercial quantities of this product. Analytical measurements such as ICP-AES and H-NMR have been used to analyze the Low-Ox TMAl and the stability of its manufacturing process. Oxygen levels in our Low-Ox TMAl are consistently < 1 ppm as measured by H-NMR, and the Si levels, measured by ICP-AES, are < 0.3 ppm.

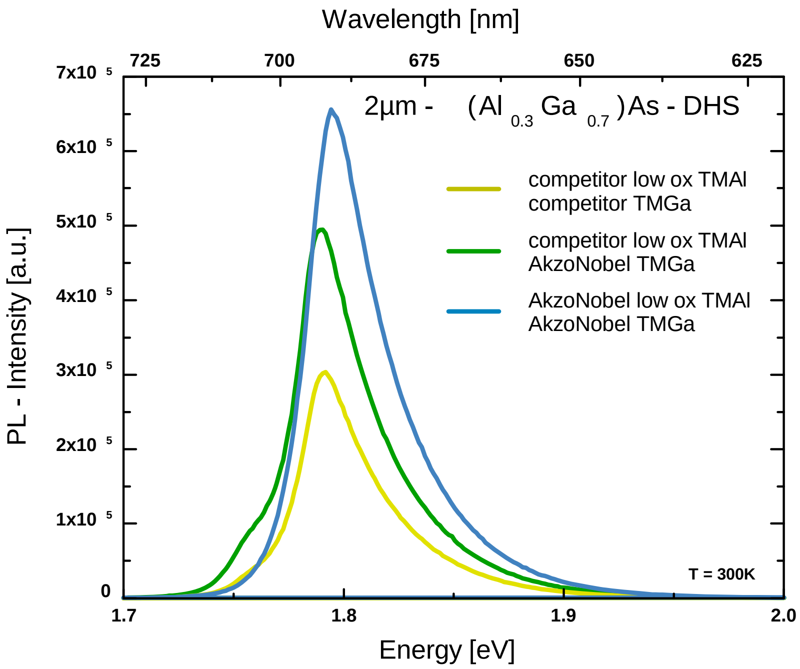
This low Oxygen level translates to low Oxygen incorporation in III-V semiconductor epitaxial layers which are grown using our Low-Ox TMAl precursor. Excellent results have been obtained at many customer locations. One such result is shown in Figure 1. This figure shows SIMS analysis performed on an $Al_{0.2}Ga_{0.8}As/Al_{0.9}Ga_{0.1}As$ super lattice grown by MOVPE at varying temperatures and V:III ratios. Note that for all growth conditions the Oxygen level is below $6x10^{16}$ cm^{-3} in the 90% AlGaAs layers and below $2x10^{16}$ cm^{-3} in the 20% AlGaAs layers even at growth temperatures as low as 660°C with V:III ratios as low as 10.

Figure 1. SIMS analysis of a 20%/90% AlGaAs super lattice. Representative layers were grown at 660°C and 690°C with V:III ratios of 10, 15, 50



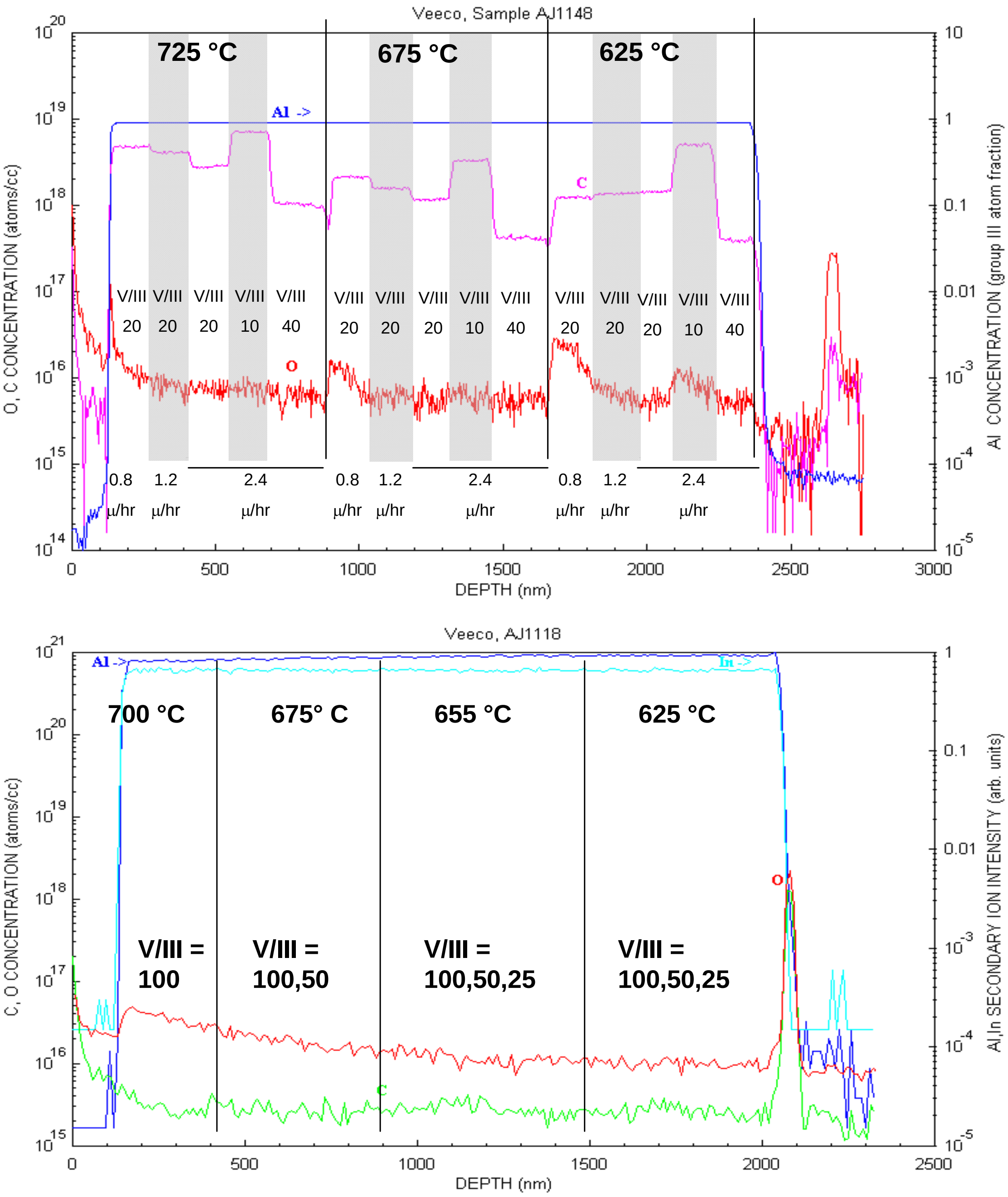
The high purity of our Low-Ox TMAl also translates to better optical material quality. Photoluminescence (PL) measurements were performed on AlGaAs DH structures. Figure 2 shows the PL spectra from three DH structures grown with differing MO source materials. It is clear that the AkzoNobel HPMO Low-Ox TMAl improved luminescence. It is also interesting to note that the highest photoluminescence efficiencies were obtained using both AkzoNobel HPMO TMGa and Low-Ox TMAl.

Figure 2. Photoluminescence study of AlGaAs layers grown using AkzoNobel HPMO's MO sources and competitors' MO sources



Low Ox TMAl was also used as part of a larger study that was reported at the 11th European Workshop on MOVPE in Lausanne, Switzerland by tool manufacturer, Veeco. In this study, $Al_{0.85}Ga_{0.15}As$ layers were grown with varying growth rates, V:III ratios and growth temperatures using a Turbodisc E300LDM MOCVD tool. The SIMS trace is shown in Figure 3a. The measured Oxygen levels were the highest for low growth rates which is consistent with background oxygen contamination and not the oxygen present in the TMAl. This study also included $Al_{0.35}Ga_{0.15}In_{0.5}P$ grown at varying V:III ratios and varying growth temperatures. Figure 3b shows a SIMS trace of this structure for which no significant variation in Oxygen was shown as a function a growth conditions, moreover, all Oxygen levels were below $3x10^{16}$ cm^{-3} for growth temperatures below 700°C.

Figure 3. SIMS trace



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