SAFC Hitech™ Enabling Technology

technical bulletin

EpiPure™ Trimethylindium (TMI)

EpiPure™ TMI is suitable for all applications where oxygen impurities are critical to the material performance. It has shown improved performance in HBLED applications. The EpiPure™ process was developed to reduce the possibility of oxygen contamination throughout by eliminating the use of ether-based raw materials and minimizing the external incorporation of oxygen. The philosophy is further extended to the analysis and transfilling stages.

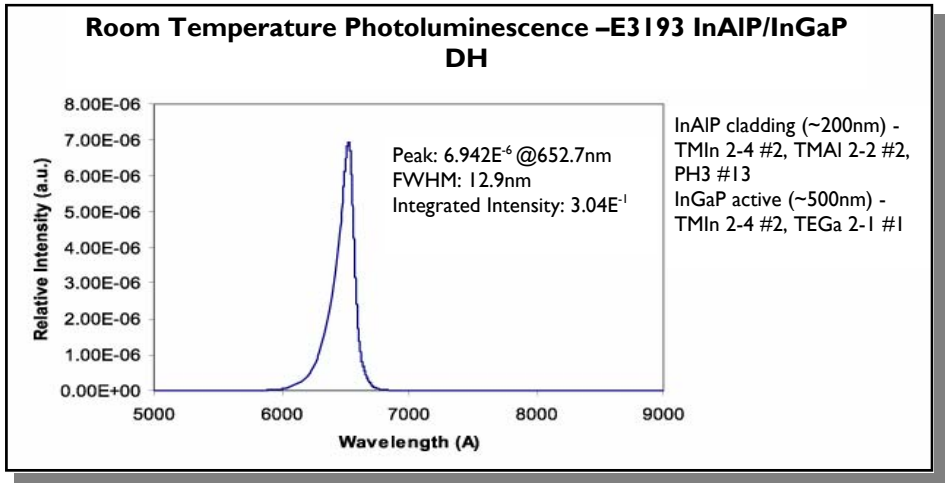
The EpiPure™ TMI process retains the proprietary adduct grade technology while integrating oxygen-free processing. This has resulted in very low levels of metallic impurities and oxygen species, such as ether and alkoxides.

Each batch of EpiPure™ TMI is certified by proton Fourier Transform Nuclear Magnetic Resonance (FTNMR) spectroscopy. The impurity peak heights are compared against internal calibration standards to provide accurate values at ultra-high sensitivities. SAFC Hitech's continued improvement program is targeting even lower Oxygen detection limits for the near future.

A side-by-side comparison of high aluminum content layers grown by MOVPE from EpiPure™ TMI to those grown from standard adduct purified solid TMI confirmed lower levels of oxygen in EpiPure™ material.

A standard structure was developed by Russ Dupuis at University of Texas at Austin to test the oxygen contamination in the indium source. This test material was an InGaAlP double heterostructure (DH) with InAlP upper and lower cladding layers, 100 and 200 nm thick respectively. The active region was lattice-matched InGaP that was about 500 nm thick. The wafer grown from EpiPure™ TMI (Figure 1) was brighter in PL intensity than that grown from the standard adduct grade TMI. Indeed, EpiPure™ TMI produced "flashlight samples," wafers that luminesce visibly when excited by a simple flashlight.

Figure 1



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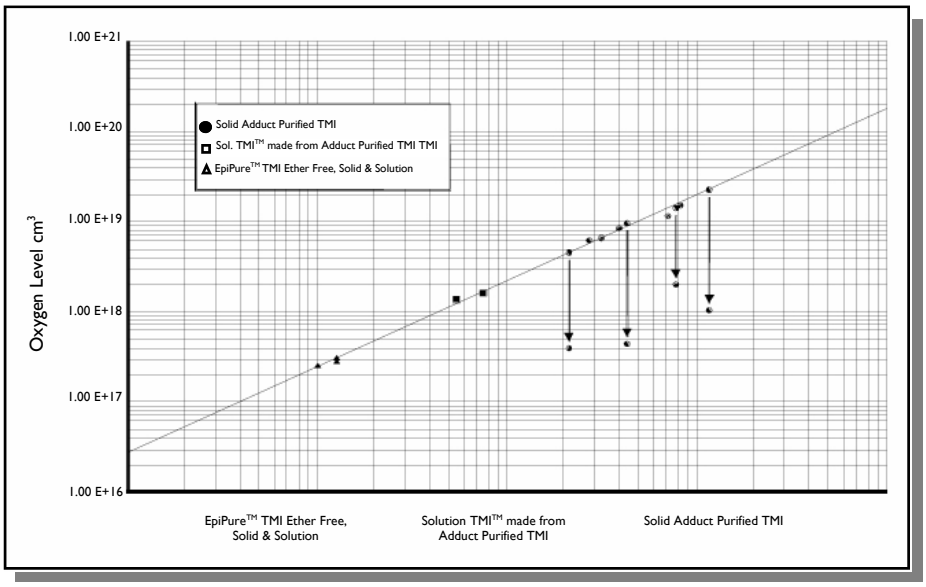
730 nm and 800 nm InAlGaAs single quantum well GRINSCH laser diodes have been grown by MOVPE by John Roberts et al at Sheffield University, UK, from adduct purified TMI , EpiPure™ TMI and Solution TMI™ produced from adduct purified TMI. The relatively large aluminum fraction (about 34%) in the quantum well results in a high affinity for oxygen, making the MOVPE process very critical to reagent quality. Any volatile oxygen impurities in the sources would reduce the device lifetimes by increasing the threshold and operating currents under high power conditions. 730 nm lasers grown using solid EpiPure™ TMI showed lower threshold currents and longer lifetimes for the same waveguide geometry.

Oxygen levels in EpiPure™ TMI are reduced by an order of magnitude as demonstrated by the SIMS data on AlInAs grown at Epitaxial Products International, UK. EpiPure™ TMI, both as a solid source and as Solution TMI™, gave layers with the lowest oxygen levels (Figure 2). The solid adduct purified source performed less satisfactorily, but it improved with use, as the volatile TMI etherate adduct purged out. Solution TMI™ made from adduct purified material showed an Immediate advantage over this source, with oxygen levels even at the start of use about one order of magnitude lower.

Figure 2



EpiPure™ TMI has demonstrated outstanding results in producing layers of low oxygen content. This has been demonstrated by PL, SIMS and the performance of a wide range of devices, such as lasers and HBLEDs. SAFC Hitech is currently moving from pilot plant to full scale production, and EpiPure™ TMI will be soon be available both as a solid source and as Solution TMI™.