APPLICATION NOTE

EAG℠
Evans Analytical Group

AN 387

Improved Characterization of Interface Contamination in a Laser Diode using Backside SIMS

May 7, 2007 (Version 3.0)

Discussion

The presence of contamination in semiconductor devices is known to affect their performance. Secondary Ion Mass Spectrometry (SIMS) is a proven analytical tool for materials haracterization. However, standard SIMS profiling sometimes cannot distinguish contamination from SIMS artifacts such as instrument memory effects.

Backside SIMS was used successfully to study the contamination of In at the epi-substrate interface in a laser diode. The data illustrates the excellent control of polishing depth, minimal surface roughness and excellent planar control.

Primary ions are employed to sputter the surface and sensitive mass spectrometry techniques allow for the detection of mass separated secondary ions. Unfortunately the sputtering mechanism may introduce memory effects which result in a significant rise of the background signal and renders the data useless to evaluate contaminants at the impurity level in the underlying layers.

Backside SIMS avoids this problem by polishing away the substrate down to the depth of interest and then profiling from the backside through the substrate into the semiconductor.

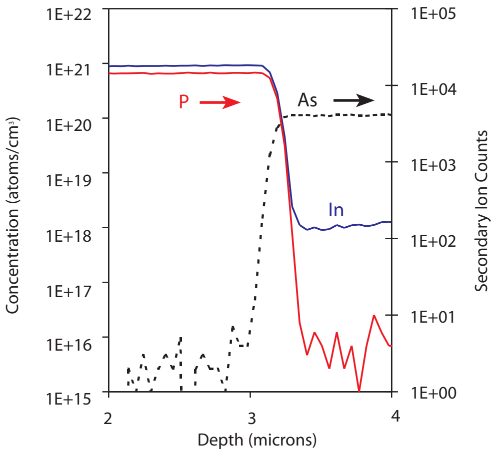

Figure 1 SIMS depth profile of In that was acquired by sputtering from the front of the laser diode

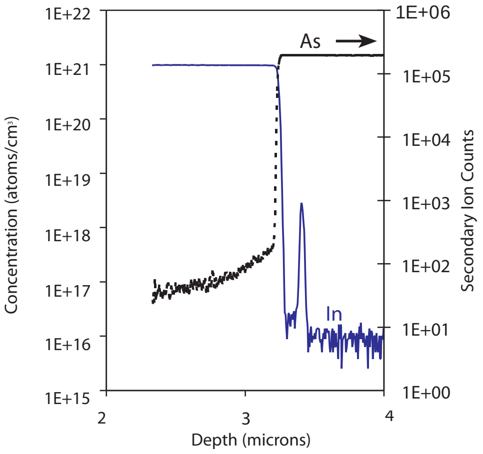

Figure 2 Backside SIMS depth profile of In in a laser diode

An example of the merits of Backside SIMS is illustrated in the two graphs above. A 350 micron thick GaAs substrate with a laser diode was polished down to about 1.5 microns from the area of interest to determine whether there is any In present at the interface between the epitaxial buffer layer and the GaAs substrate. Figure 1 shows a conventional SIMS depth profile of the In concentration throughout a laser diode structure. The high In background signal in the GaAs substrate is due to memory effects as the top epi layers contain In at the matrix levels. Figure 2 shows the Backside SIMS depth profile of the In concentration when profiling from the back into the epi layers. The depth resolution is 100 Å per decade and a low background for In was achieved. The data clearly show that there is some In contamination present at the epi/substrate interface.

The data illustrates that contaminants can be measured at low levels and excellent depth resolution can be achieved after polishing away the majority of the material. Backside SIMS offers a powerful extension of the mature SIMS technique to study materials issues which were previously not possible or were deferred to less sensitive techniques for the lack of a practical SIMS solution.

United States Locations

Tempe, Arizona
+1 480 239 0602 info.az@eaglabs.com
+1 602 470 2655 fax

Sunnyvale, California
810 Kifer Road
+1 408 530 3500 info.ca@eaglabs.com
+1 408 530 3501 fax

1135 E Arques Avenue
+1 408 738 3033
+1 408 738 3035 fax

785 Lucerne Drive
+1 408 737 3892
+1 408 737 3916 fax

Peabody, Massachusetts
+1 978 278 9500 info.ma@eaglabs.com
+1 978 278 9501 fax

Chanhassen, Minnesota
+1 952 828 6411 info.mn@eaglabs.com
+1 952 828 6449 fax

East Windsor, New Jersey
+1 609 371 4800 info.nj@eaglabs.com
+1 609 371 5666 fax

Syracuse, New York
+1 315 431 9900 info.ny@eaglabs.com
+1 315 431 9800 fax

Raleigh, North Carolina
+1 919 829 7041 info.nc@eaglabs.com
+1 919 829 5518 fax

Round Rock, Texas
+1 512 671 9500 info.tx@eaglabs.com
+1 512 671 9501 fax

International Locations

Shanghai, China
+ 86 21 6879 6088 info.cn@eaglabs.com
+ 86 21 6879 9086 fax

Tournefeuille, France
+ 33 5 61 73 15 29 info.fr@eaglabs.com
+ 33 5 61 73 15 67 fax

Frankfurt, Germany
+ 49 (0) 693053213 info.de@eaglabs.com
+ 49 (0) 69307941 fax

Tokyo, Japan
+ 81 3 5396 0531 info.jp@eaglabs.com
+ 81 3 5396 1930 fax

HsinChu, Taiwan
+ 886 3 5632303 info.tw@eaglabs.com
+ 886 3 5632306 fax

Uxbridge, United Kingdom
+ 44 (0) 1895 811194 info.uk@eaglabs.com
+ 44 (0) 1895 810350 fax