Analytical and Bioanalytical Chemistry

Electronic Supplementary Material

Direct chemical in-depth profile analysis and thickness quantification of nanometer multilayers using pulsed-rf-GD-TOFMS.

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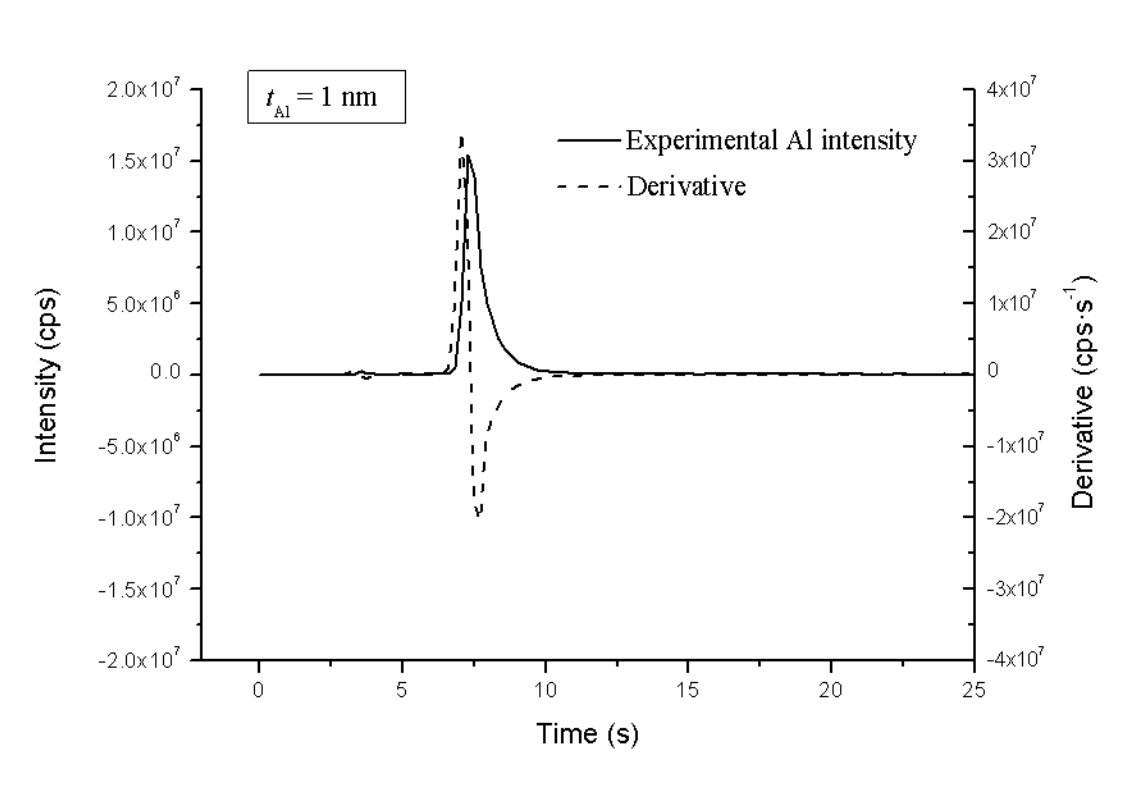
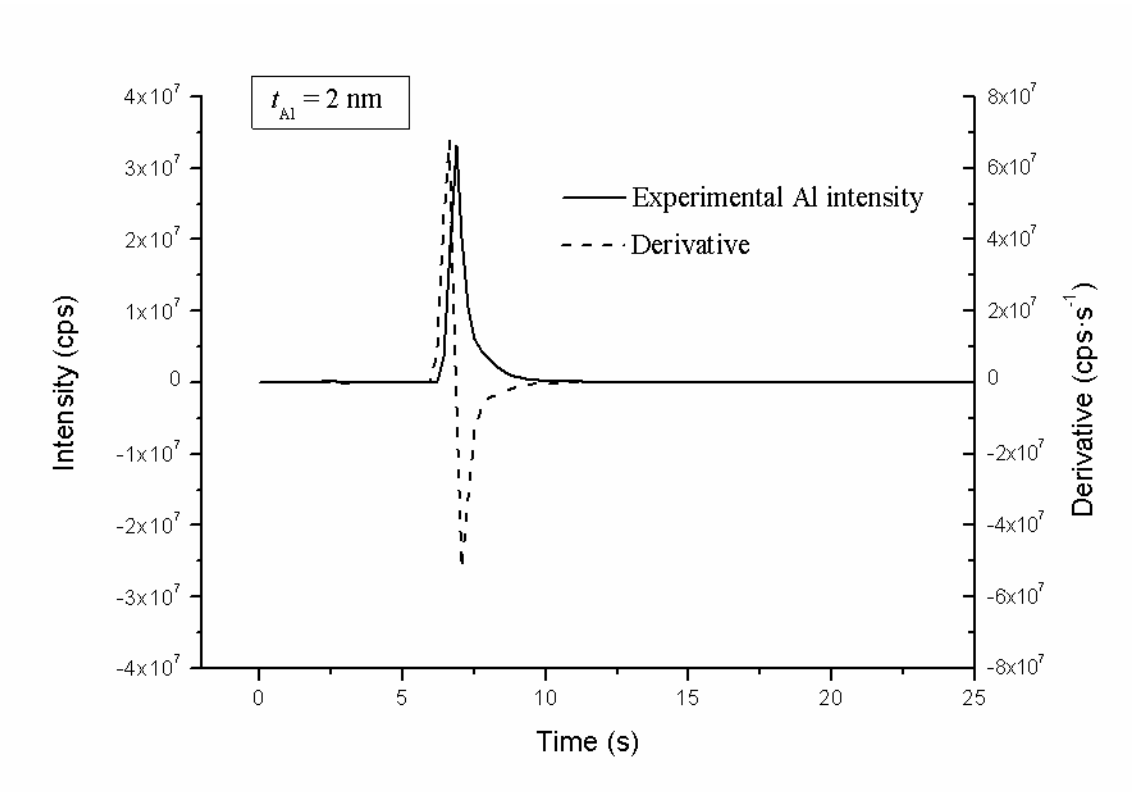
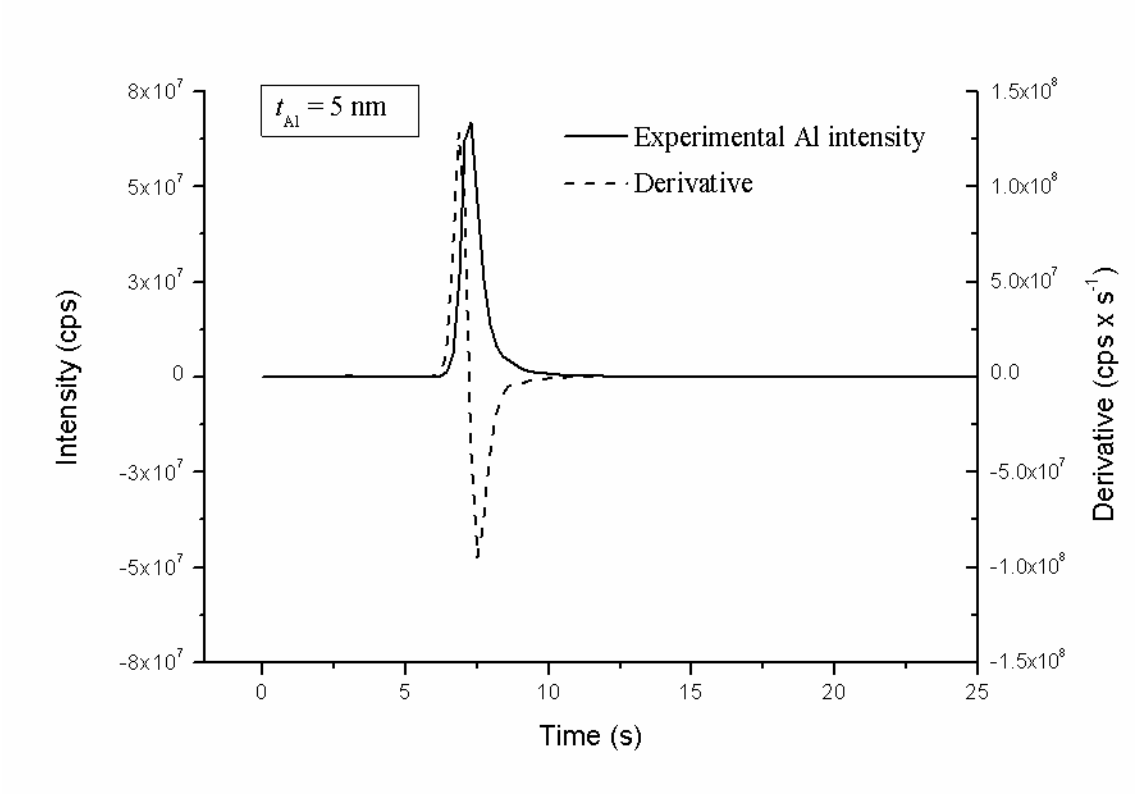
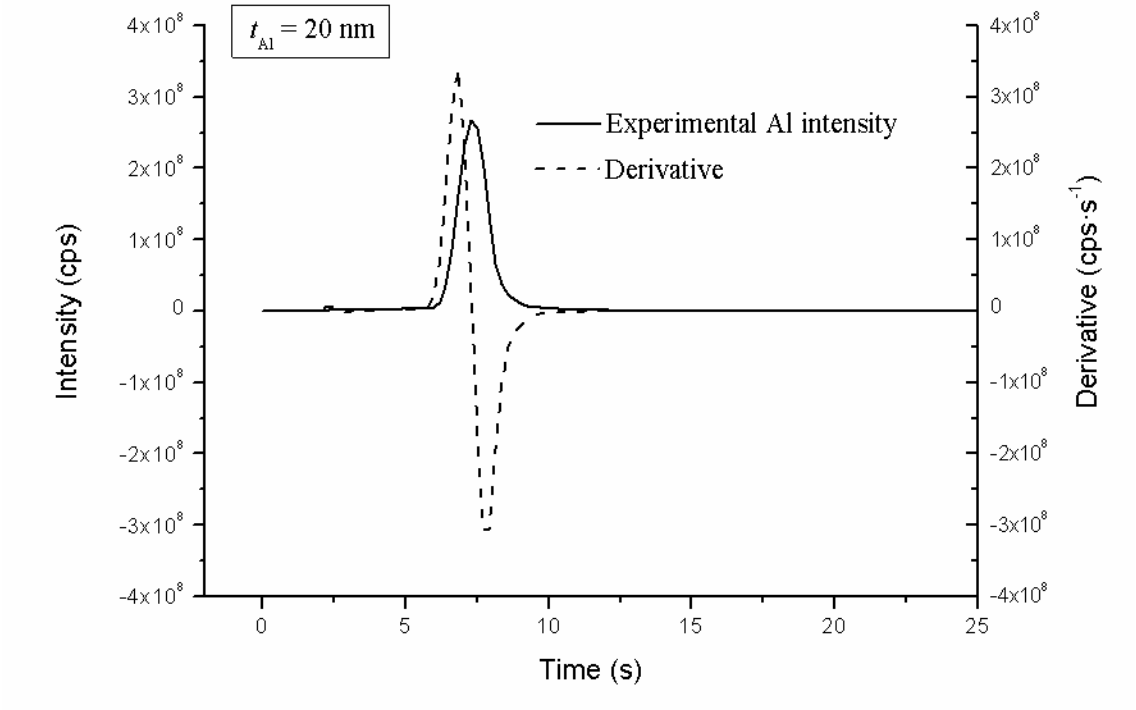
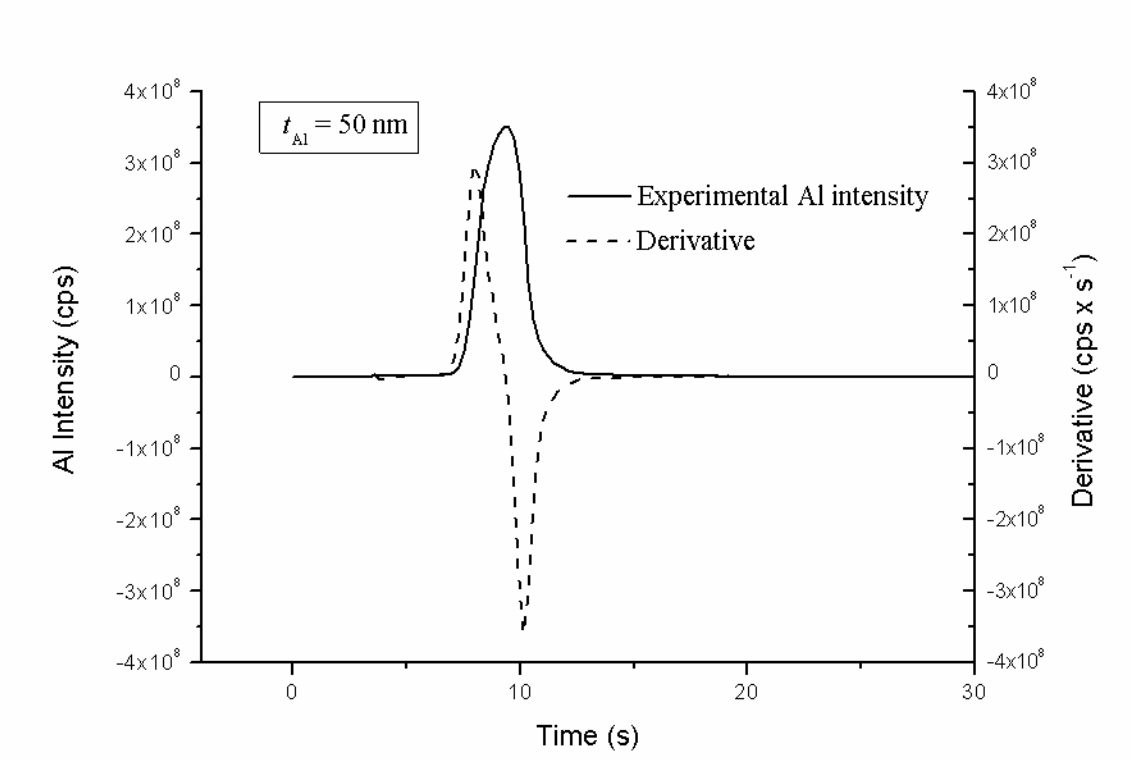
Figure S1: Experimental Al^+ signal profiles and their mathematical derivatives






t_{Al} = 5 nm
Experimental Al intensity
Derivative
Intensity (cps)
Derivative (cps x s^{-1})
Time (s)
8x10^7
5x10^7
3x10^7
0
-3x10^7
-5x10^7
-8x10^7
1.5x10^8
1.0x10^8
5.0x10^7
0.0
-5.0x10^7
-1.0x10^8
-1.5x10^8
0
5
10
15
20
25


t_{Al} = 20 nm
Experimental Al intensity
Derivative
Intensity (cps)
Derivative (cps·s^{-1})
Time (s)
4x10^8
3x10^8
2x10^8
1x10^8
0
-1x10^8
-2x10^8
-3x10^8
-4x10^8
0
5
10
15
20
25



This figure shows the different Al^+ qualitative profiles and their corresponding derivative functions, which are used to obtain the maximum slopes of each profile. Afterwards, applying the method of the inverse maximum slope (S. Hofmann, From depth resolution to depth resolution function: refinement of the concept for delta layers, single layers and multilayers, Surf. Interface Anal., 1999, 27, 825-834) to the Al signal at the Nb/Al interface, a time resolution between 0.44 and 1.0 s can be estimated. These are the obtained results:

t_{Al} (nm)	□□Al$^+$) (cps)	(d□/dt)$_{max}$	□t (s)
50 nm	3.5E+08	3.4E+08	1.03
20 nm	2.6E+08	3.0E+08	0.88
5 nm	6.6E+07	1.3E+08	0.52
2 nm	3.3E+07	6.8E+07	0.48
1 nm	1.5E+07	3.4E+07	0.44

If we consider a constant sputtering rate at the Nb/Al interface, given by the sputtering rate at the Nb layer (~ 12 nm/s), the depth resolution could be estimated:

t_{Al} (nm)	□z (nm)
50 nm	12
20 nm	11
5 nm	6
2 nm	6
1 nm	5