Supporting Information

The Consequence of Galvanic Displacement Reaction on Digital Photocorrosion of GaAs/ $Al_{0.35}Ga_{0.65}As$ Nanoheterostructures

Amanpreet Singh, René St-Onge, Jan J. Dubowski*

Laboratory for Quantum Semiconductors and Photon-Based BioNanotechnology, Interdisciplinary Institute for Technological Innovation (3IT), CNRS UMI-3463, Department of Electrical and Computer Engineering, Université de Sherbrooke, 3000 boul. de l' Université, Sherbrooke, Québec J1K 0A5, Canada

Functionalization procedure: Surface functionalization of GaAs quantum well microstructure

(a) Washing: The Chips of 2 mm × 2 mm dimensions were chopped from GaAs wafer and sequentially cleaned with acetone, OptiClear, acetone, and isopropanol through 5-minute sonication in each solvent. The cleaning of the sample was required to remove photoresist and some organic impurities from the surface. Further, the samples were treated with an ammonium hydroxide solution (28%) for two minutes to remove native oxides and, finally, washed with degassed ethanol.

(b) **Thiolation**: To deposit a mixed thiol self-assembled monolayer (SAM) on the surface of GaAs substrate, the washed sample was incubated in 1 mL solution of Hexadecanethiol (HDT) (1.87 mM) and PEG biotin thiol (0.13 mM) in degassed ethanol for twenty hours. The thiolated biochip was washed with ethanol to remove non-covalently attached thiol.

Note: The standard solution of thiols at a final concentration of 2 mM (1:15 PEG-biotin/HDT (M: M)) was prepared in degassed ethanol.

(c) **Neutravidin:** GaAs samples were incubated in 200 μg/mL of neutravidin solution in PBS buffer for two hours. The samples were washed with degassed PBS.

(d) **Biotinylated-antibody:** To functionalize the surface with specific antibodies, the biochip was exposed to 0.4 mL of 100 μg/mL PBS solution of biotinylated antibodies.

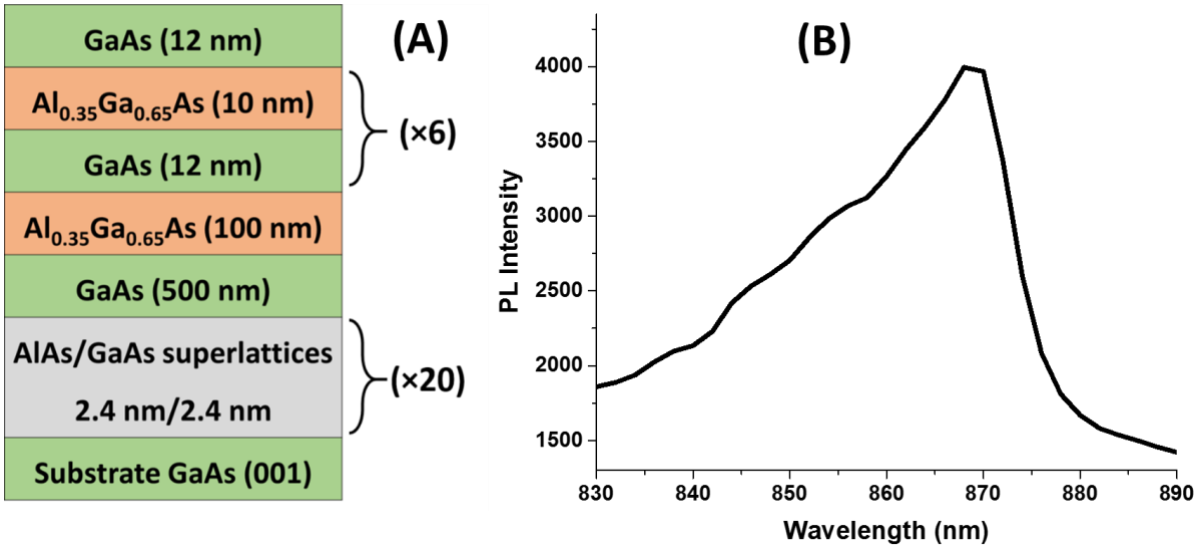

Figure S1: (A) Schematic cross-section view of GaAs/$Al_{0.35}Ga_{0.65}As$ nanoheterostructures investigated in this work, and (B) Photoluminescence spectrum of the GaAs/$Al_{0.35}Ga_{0.65}As$ nanoheterostructure showing emission at 870 nm that originates from GaAs epitaxial layers.

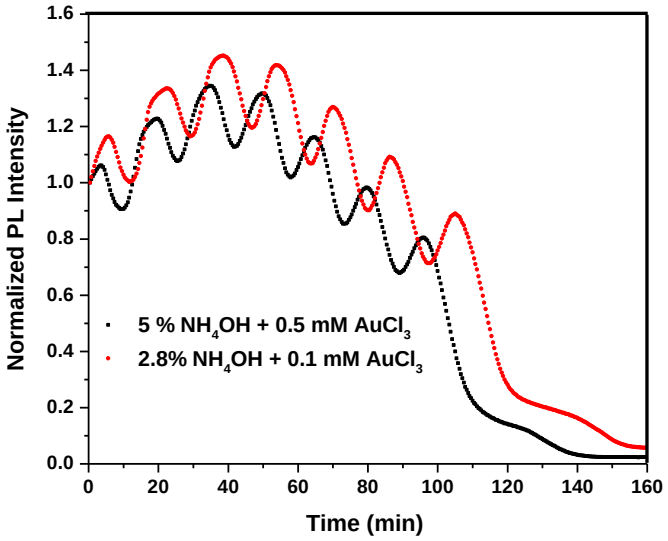

Figure S2: Temporal behaviour of PL intensity from D3422 samples photocorroding in different solvent systems (Duty Cycle = 1.8s/25s).

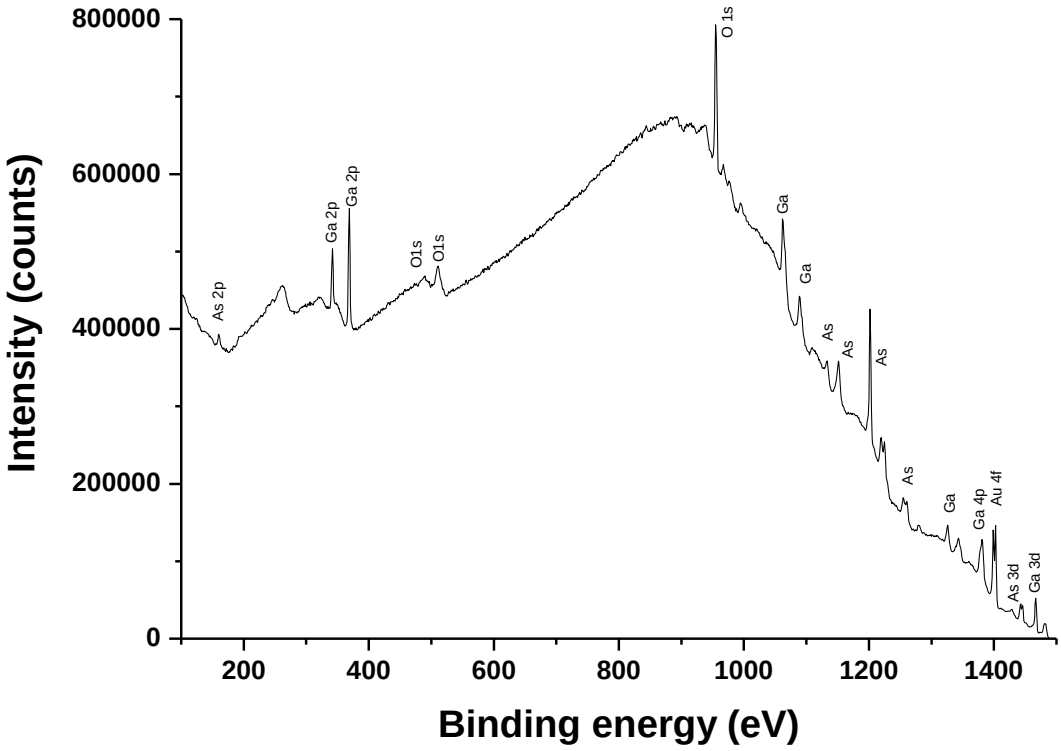

Figure S3: XPS scans of GaAs/AlGaAs nanoheterostructure after DIP under continuous flow of 0.1 mM Au^{3+} in DI water (Duty Cycle = 1.8/25, 144 cycles).

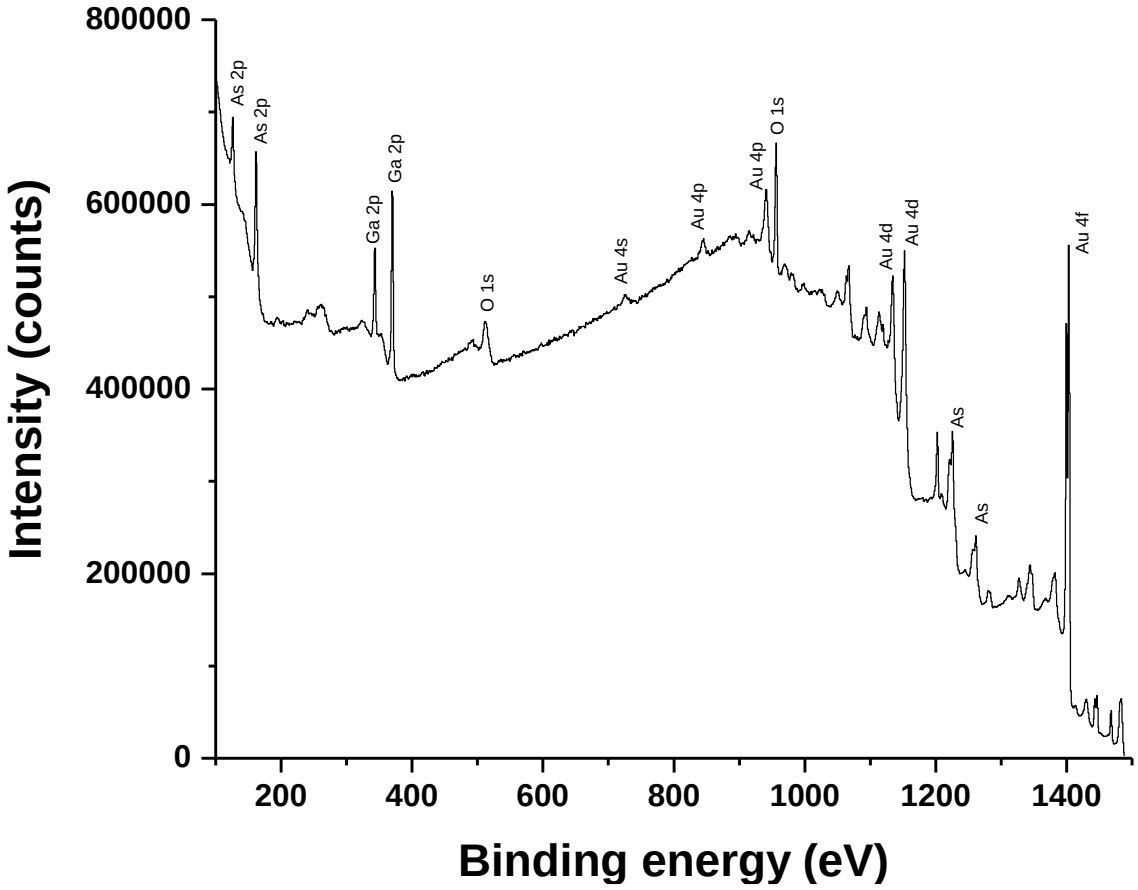

Figure S4: XPS scans of GaAs/AlGaAs nanoheterostructure after DIP under continuous flow of 0.1 mM Au^{3+} in 2.8% ammonium hydroxide (Duty Cycle = 1.8/25, 144 cycles).

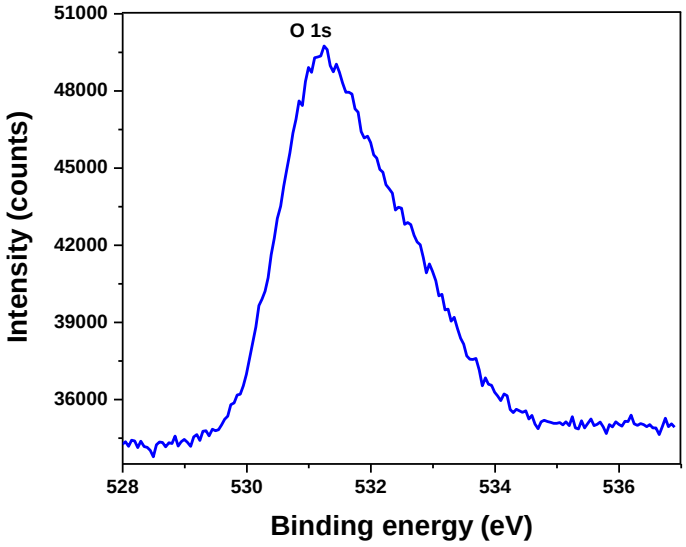

Figure S5: High-resolution XPS core level O *1s* spectrum of GaAs/AlGaAs nanoheterostructure DIP under continuous flow of 0.1 mM Au^{3+} in DI water (Duty Cycle = 1.8/25, 144 cycles).

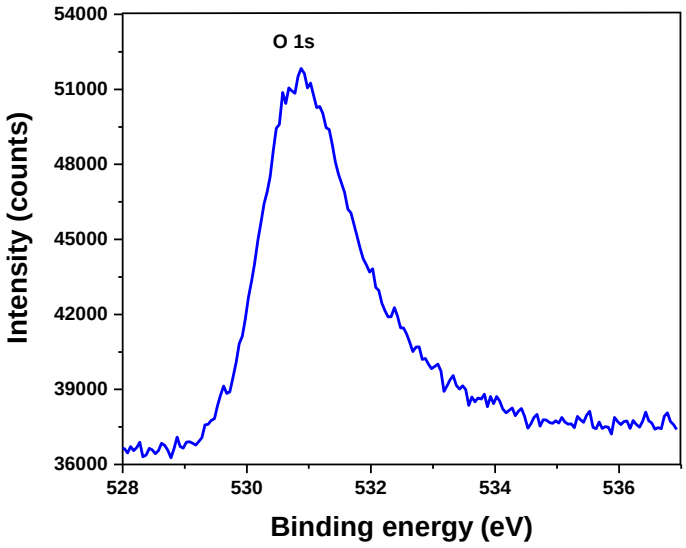

Figure S6: High-resolution XPS core level O *1s* spectrum of GaAs/AlGaAs nanoheterostructure DIP under continuous flow of 0.1 mM Au^{3+} in 2.8% ammonium hydroxide (Duty Cycle = 1.8/25, 144 cycles).