Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Galvanically replaced Au-Pd nanostructures: Study of their enhanced elemental mercury sorption capacity over gold

B. Lay [a], Y. M. Sabri[a], S. J. Ippolito[a] and S. K. Bhargava*[a]

[a] Centre for Advanced Materials and Industrial Chemistry (CAMIC) Group, School of Applied Sciences, RMIT University, Melbourne, Australia.

Fax: 613 9925 3747; Tel: 613 9925 3365;

E-mail: suresh.bhargava@rmit.edu.au

Electronic Supplementary Information

Characterization Techniques

AFM

Atomic force microscopy (AFM) tapping mode measurements were performed on the relevant films using a NanoScope IIIa Multimode AFM (Vecco, USA) under air-ambient conditions (20 °C and 40 %RH). Budget Sensors (Tap300-G) silicon etched SPM probes having a spring constant of 40 N m^{-1}, a radius of curvature of tip <10 nm, a resonant frequency of approximately 300 kHz, and cantilever dimensions of 125µm x 35µm x 4µm were used. More than 4 AFM scans were carried out on different locations for each sample, and the results presented within this manuscript are typical examples. The AFM scan analysis software was provided by Vecco Co. (USA) with the AFM instrument and was used for surface analysis.

XPS

X-ray photoelectron spectroscopy (XPS) measurements of the relevant surfaces were carried out using a Thermo K-alpha X-ray Photoelectron Spectrometer at a pressure better than 1×10^{-9}. The general scan and C1s, Au 4f and Pd 3d core level spectra for the respective samples were recorded with monochromatized Al Kα micro-focused radiation (photon energy =1253.6 eV) at a pass energy of 20 eV and electron takeoff angle of 90°. The core level binding energies (BEs) were aligned with the adventitious carbon binding energy carbon 284.8eV.

SEM

Scanning electron microscope (SEM) measurements were performed on a FEI Nova NanoSEM operated at an accelerated voltage of 15 kV.

XRD

X-ray diffraction (XRD) data were obtained with a Bruker AX 8: Discover with General Area Detector Diffraction System (GAADS) operating at a voltage of 40 kV and a current of 40 mA with Cu Kα radiation.

Figures

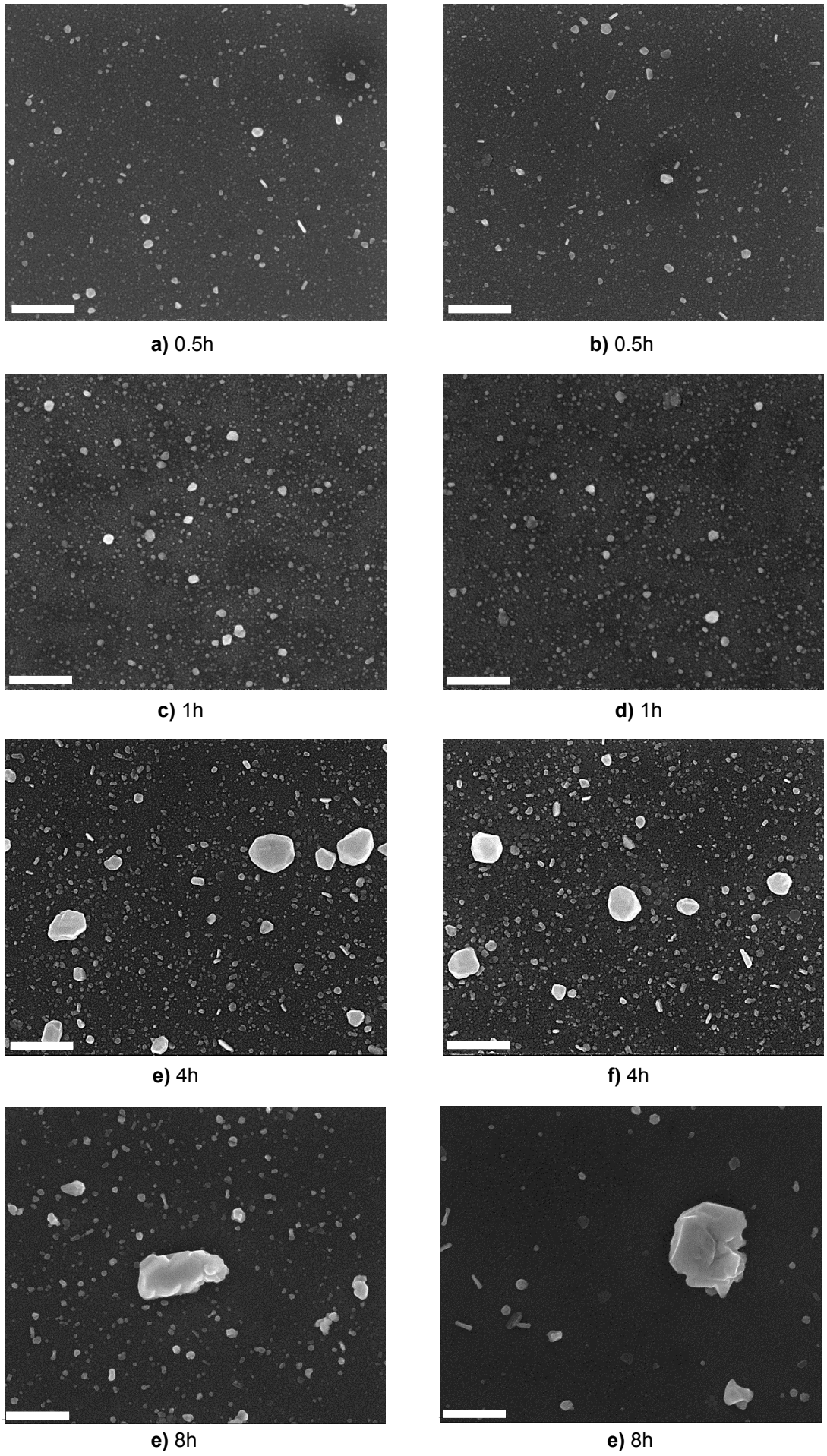
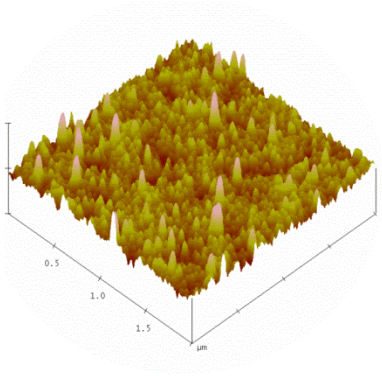
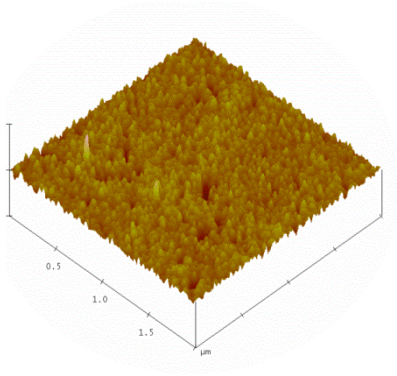


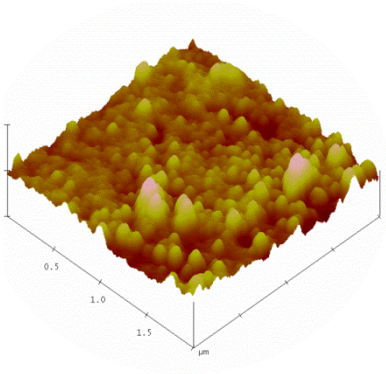
Figure S1: SEM images of Au-Pd surfaces after exposure to Hg^0 vapor. The images were captured following 48 hours of mercury exposure at concentrations ranging from 0.52 to 9.1 mg/m^3.



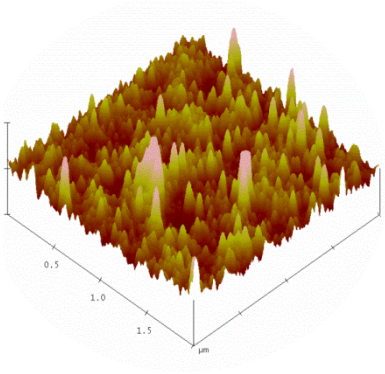
a) Pd Ctrl



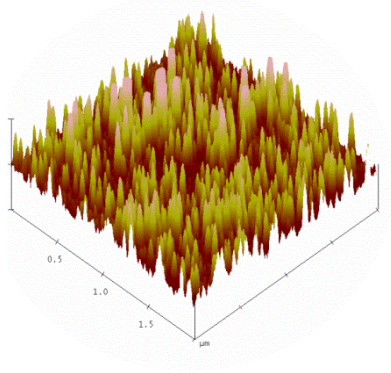
b) Au Ctrl



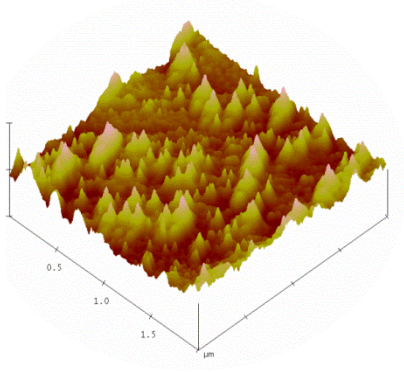
d) 0.5h



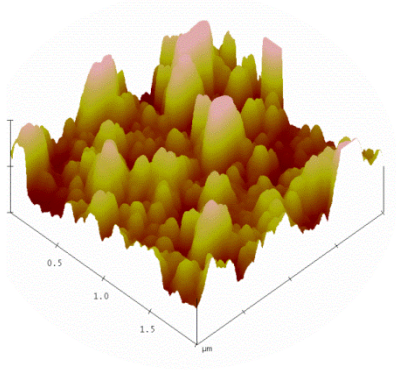
e) 1h



f) 4h



g) 8h



h) 16h

Figure S2: SEM images of Au-Pd surfaces after exposure to Hg^0 vapor

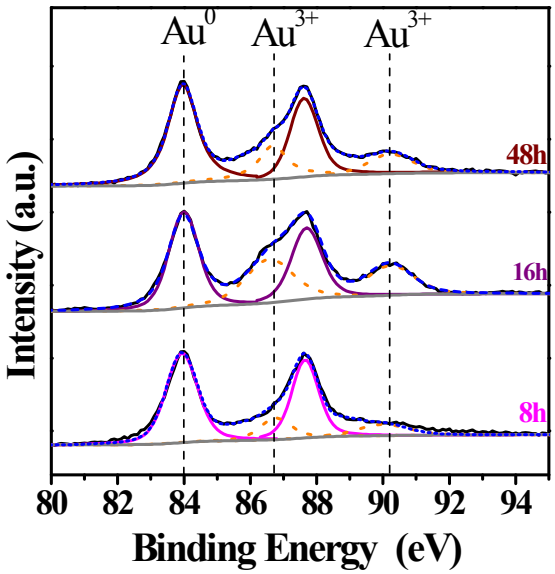


Figure S3: Deconvolution of the XPS data shown in Figure 4b of the manuscript for the 8h, 16h and 48h GR surfaces. The data demonstrates the build-up of Au^{3+} with increasing GR reaction time.

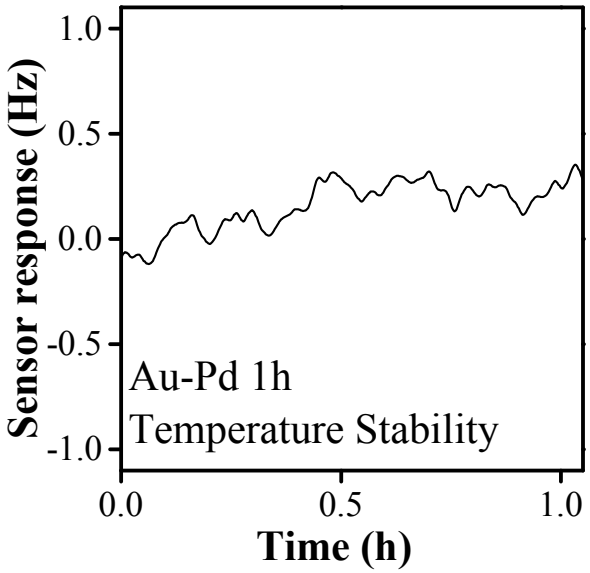


Figure S4: QCM response of 1h GR QCM towards dry N_2 gas (no Hg^0) showing the high temperature stability of the sensor over a period of one hour.

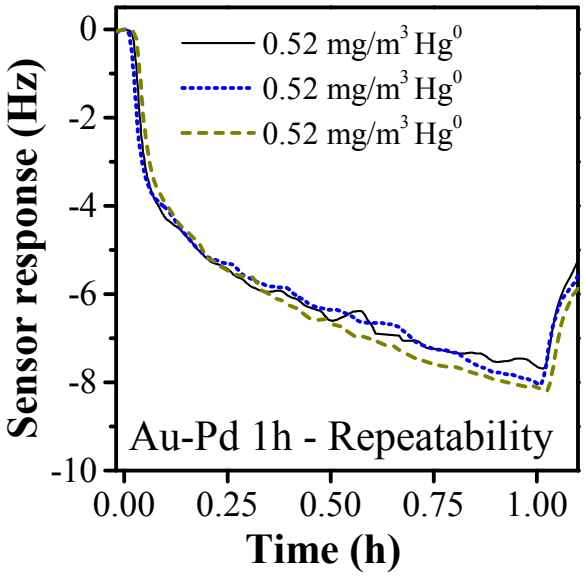


Figure S5: QCM response of GR QCM (Au-Pd 1h) towards 0.52 mg/m^3 Hg^0 vapor showing the high repeatability of the sensor over three consecutive pulses.