

# Supporting Information

## Robust Gold Organometallic Nanoparticles

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<b>Contents</b>	<b>Page</b>
Experimental section.....	3
S1. Synthesis of gold-carbon nanoparticles.....	5
S2. $^1\text{H}$ NMR of gold-carbon nanoparticles .....	6
S3. FT-IR of $[\text{C}_8\text{F}_{17}\text{-4-C}_6\text{H}_4\text{N}\equiv\text{N}]\text{AuCl}_4$ and gold-carbon nanoparticles.....	7
S4. TGA of the diazonium tetrachloroaurate(III) precursor and the gold-carbon nanoparticles.....	8
S5. TD-XRD of gold-carbon nanoparticles.....	9
S6. UV-Vis of gradual addition of sodium borohydride acetonitrile solution to 0.1 mM $[\text{C}_8\text{F}_{17}\text{-4-C}_6\text{H}_4\text{N}\equiv\text{N}]\text{Cl}$ in acetonitrile.....	10

## Experimental Section

**General Procedures.** Unless stated otherwise, all manipulations were carried out in either a N<sub>2</sub>-filled Vacuum Atmospheres Co. glove box or on a Schlenk line using N<sub>2</sub>. Toluene, acetonitrile, and C<sub>8</sub>F<sub>17</sub>-4-C<sub>6</sub>H<sub>4</sub>NH<sub>2</sub>. CDCl<sub>3</sub>, DMSO-*d*<sub>6</sub>, [NO]PF<sub>6</sub>, H[AuCl<sub>4</sub>]•3H<sub>2</sub>O, and [Bu<sub>4</sub>N]PF<sub>6</sub> were purchased from Sigma-Aldrich. All other commercially available reagents were used as received.

**Physical Measurements.** Infrared spectra were recorded in the 4000-400 cm<sup>-1</sup> range using a Perkin-Elmer FT-IR Spectrum 1000 spectrophotometer. C, H, and N analyses were carried out by Columbia Analytical Services, Tucson, Arizona. <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on a JEOL 400 MHz. Chemical shifts are reported relative to the chloroform solvent peak. The thermal stability (weight loss behavior) was studied using a Perkin-Elmer TG/DTA Thermogravimetric analyzer. The scan rate was set at a 2 °C/min from room temperature to 500 °C. The TGA analysis was carried out in air and in argon atmosphere. Residual gas analyses were carried out using RGA Pro 2000 from Stanford Research Systems. Non-ambient (Temperature Program) X-ray diffraction analysis was carried out on a Panalytical X'Pert Pro X-ray Diffractometer (Model PW3040 Pro) using copper K-alpha radiation ( $\lambda = 0.154178$  nm). The instrument was operated at 40 KV and 20 mA on an HTK 1200 oven stage. XPS was measured at Texas A&M University, College Station, using Kratos Axis Ultra Imaging X-ray photoelectron spectrometer with mono Al anode excitation source at 10 KA and 12 KV.

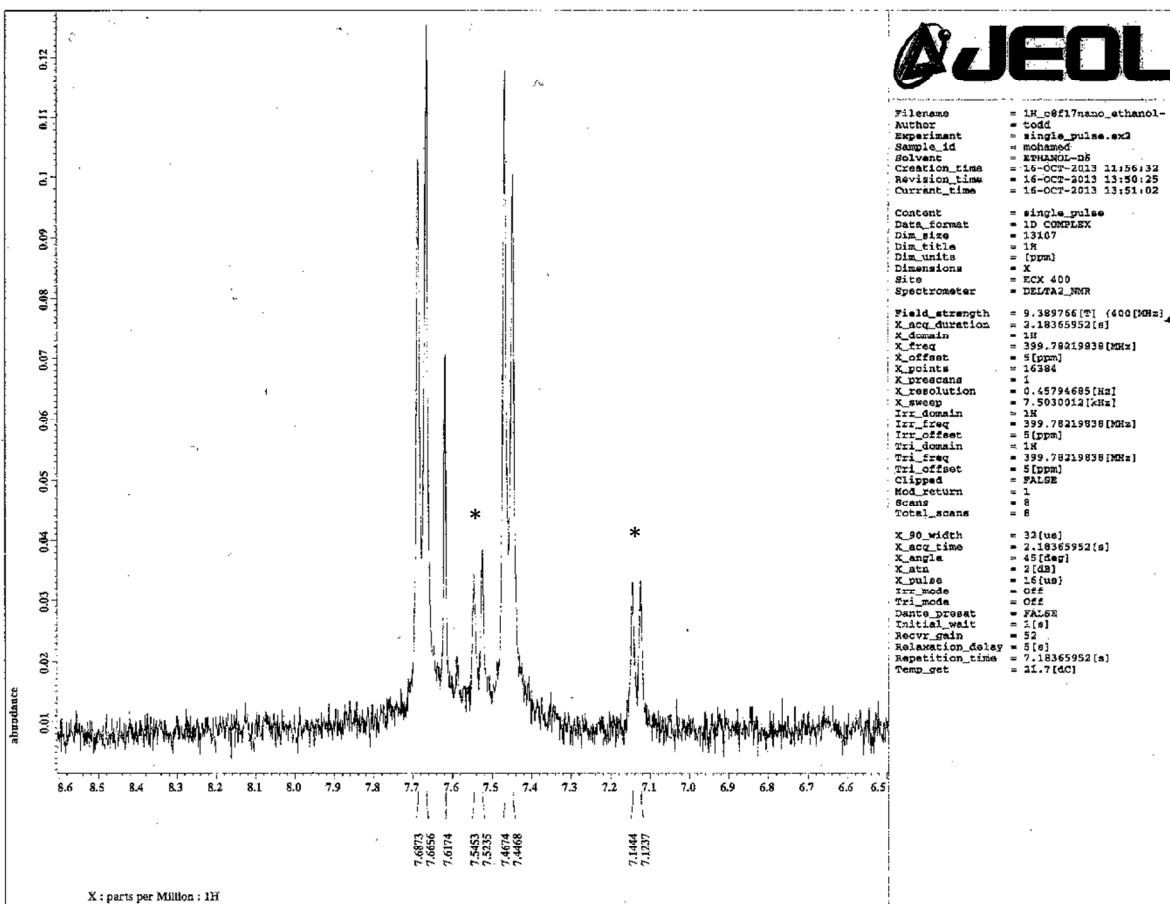
**Nanoparticles Track Analyzer (NTA).** Solutions were diluted to an approximate concentration range of 10<sup>9</sup> gold nanoparticles per mL of ethanol, and injected via a 1 mL disposable syringe into a Nanosight LM20 (Nanosight, Amesbury, United Kingdom) equipped with a 633 nm laser and low sensitivity detector. Rinsing with filtered DI water between samples cleaned the liquid cell. Fresh DI water, post-rinsing, was checked to ensure no cross-contamination of gold

nanoparticles occurred. The optics were adjusted by finding the immobile area of diffraction from the laser beam, or the so-called fingerprint area, and moving the liquid cell so that the volume closest to the fingerprint without interferences was the volume observed. Camera settings were adjusted empirically by maximizing the brightness of the AuNPs while minimizing any background light. Videos were collected for 90 s. Post-collection analysis parameters were adjusted empirically to maximize the number of particles correctly identified by the proprietary software (NTA version 2.0) while simultaneously minimizing the number of noisy pixels incorrectly identified.

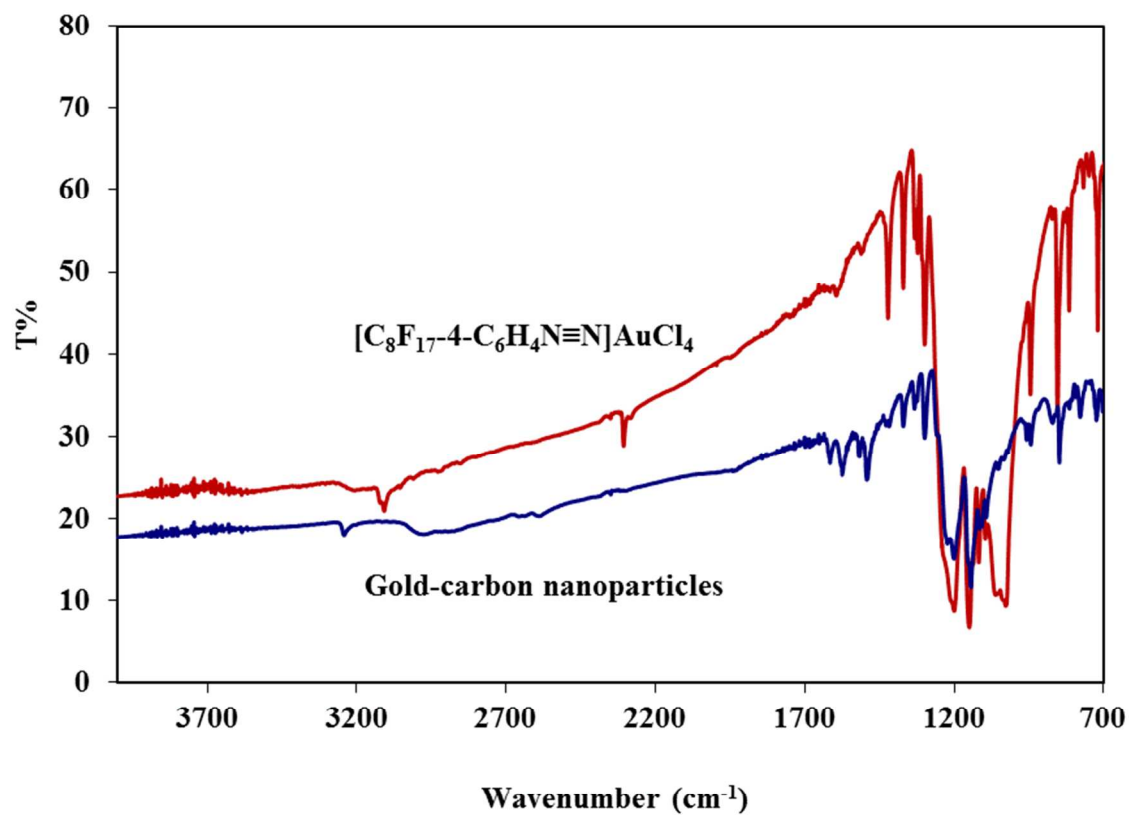
**Transmission Electron Microscopy.** As-fabricated specimen powder was added to adequate amount of ethanol and the solution was sonicated for 5 min before a drop of the dispersion was transferred to a TEM grid with C-film support. The grid with sample dispersion was left to dry in ambient environment. A JEM-2010F operating at 200kV was used to collect images and perform other analyses. The nanoparticles counting and analysis were performed using ImageJ program. All nanoparticles in the images were included in the count.

## **S1. Synthesis of gold-carbon nanoparticles**

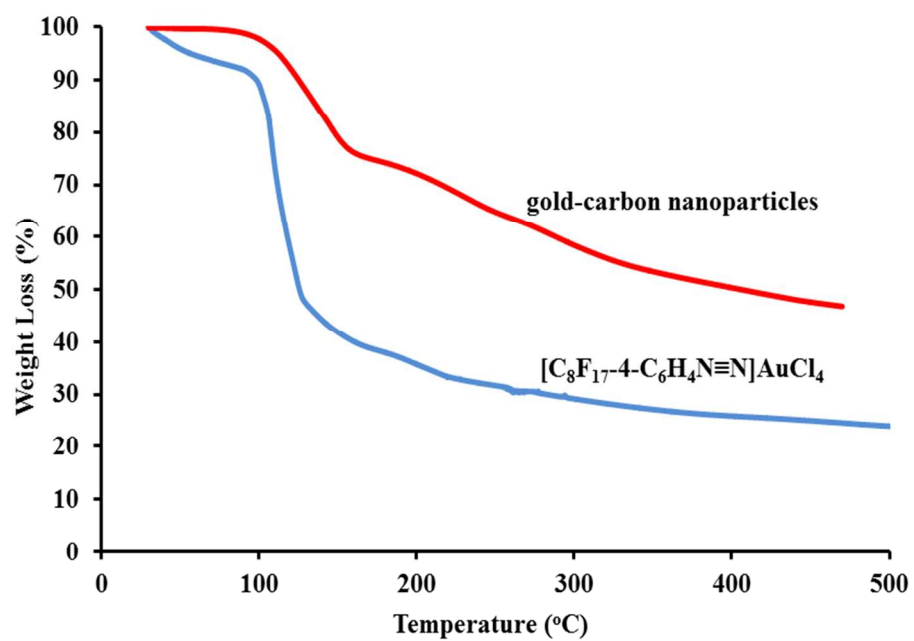
Sodium borohydride (2.4 mmol) in 20 mL anhydrous acetonitrile was added dropwise over one hour to 100 mL anhydrous acetonitrile solution of  $[\text{C}_8\text{F}_{17}\text{-4-C}_6\text{H}_4\text{N}\equiv\text{N}]\text{AuCl}_4$  (2.1 mmol) under vigorous stirring. Upon the addition of the borohydride reducing agent nitrogen gas was evolved and the color changed from yellow to ruby red. The solvent volume was decreased under reduced pressure to 5 mL and the reaction was then treated with 70 mL toluene and washed with 0.5 M  $\text{H}_2\text{SO}_4$  (2 x 30 mL), 0.5 M  $\text{Na}_2\text{CO}_3$  (2 x 30 mL), Milli-Q water, and dried over  $\text{MgSO}_4$ . Subsequently, the solvent was removed under reduced pressure with a rotary evaporator. The nanoparticles were suspended in acetonitrile, centrifuged for 10 min at 1500 rpm, and collected over glass frit funnel and washed with ethanol. The nanoparticles did not lose their solubility in acetonitrile when exposed to air for a long period of time.



S2.  $^1\text{H}$  NMR of gold-carbon nanoparticles in  $\text{C}_2\text{D}_5\text{OD}$ .

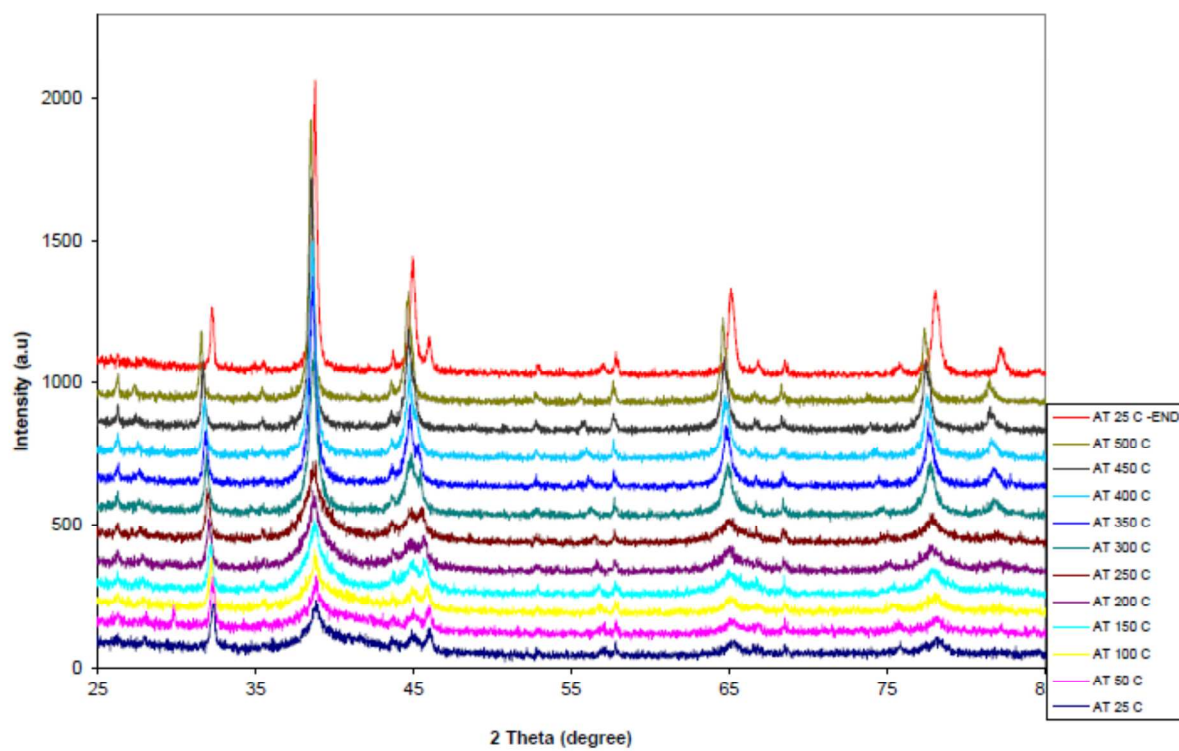


**S3. FT-IR of [C<sub>8</sub>F<sub>17</sub>-4-C<sub>6</sub>H<sub>4</sub>N≡N]AuCl<sub>4</sub> and gold-carbon nanoparticles**

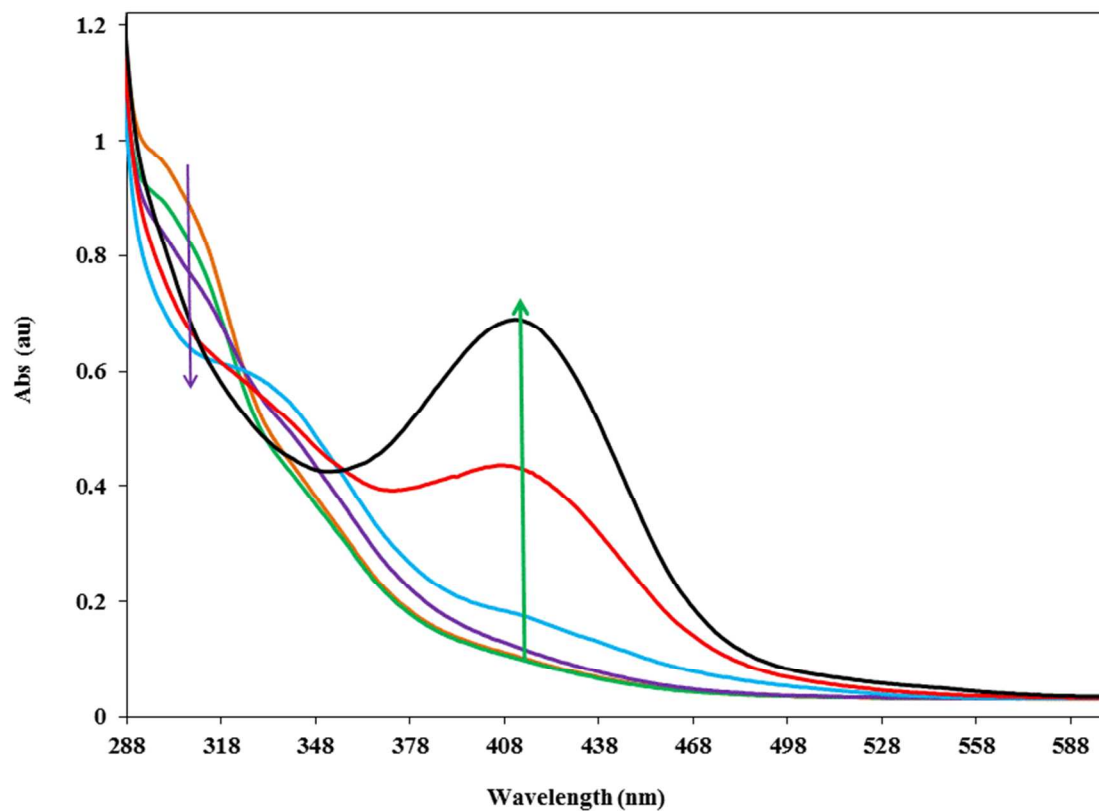


**S4. TGA of the diazonium tetrachloroaurate(III) precursor and the gold-carbon nanoparticles.**





**S5. TD-XRD of gold-carbon nanoparticles**



**S6. UV-Vis of gradual addition of sodium borohydride acetonitrile solution to 0.1 mM  $[C_8F_{17}-4-C_6H_4N\equiv N]Cl$  in acetonitrile.**