Figure S1. (a) Raman spectra of highly oriented pyrolytic graphite (HOPG), graphene oxide (GO), and reduced graphene oxide (rGO). (b) XPS spectra of C 1s for rGO and GO.

In Raman spectra, the first-order G- and D-band originated from vibrations of sp² carbon appearing at around 1600 and 1350 cm⁻¹, respectively. The intensity ratio of the D and G peaks increased as GO sheets (D/G =0.81) converted to the rGO sheets (D/G=1.02). This is due to an increase in defect density corresponding to the defunctionalized epoxide and hydroxyl groups in the basal plane. Raman spectroscopy (Reinshaw, RM1000-In Via) was obtained with excitation energy of 2.41 eV (514 nm). In XPS data, one major peak was observed in rGO for carbon-carbon peak of C=C/C= (284.6 eV) due to sp³ carbon bonding,
as carbon-oxygen peaks of C–O (286.1 eV), C=O (287.5 eV), and C(=O)–OH (289.2 eV) due to sp³ carbon bonding (in graphene oxide) was drastically diminished.

**Fig. S2.** (a)–(c) *I/V* curves representing conductance switching to the electron affinity levels of Fe^{II}, Ru^{II}, and Co^{II}(tpyphs)₂ complexes in STM-based junctions, respectively.
**Fig. S3.** Topographical AFM image of an rGO film on the Co^{II}(tpyphs)_{2} SAM/gold.

Thickness of the rGO film on SAMs was measured by about 20 nm, considering the length of molecules.

**Fig. S4.** (a) $I/V$ curves in Au/rGO film/Ru^{III}(tpyphs)_{2} SAM/Au devices, showing three distinguishable conductance states. (b) A statistical distribution of threshold voltage for
conductance switching in Au/rGO film/Ru$^{II}$(tpyphs)$_2$ SAM/Au devices. (c) $I/V$ curve in an Au/rGO film/Co$^{II}$(tpyphs)$_2$ SAM/Au device. (d) A statistical distribution of threshold voltage for conductance switching in Au/rGO film/Co$^{II}$(tpyphs)$_2$ SAM/Au devices.