Supplementary Material (ESI) for Chemical Communications

Aptamer-Based Fluorescence Sensor for Rapid Detection of Potassium Ions in Urine

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EXPERIMENTAL SECTION

Chemicals. Tris(hydroxymethyl)aminomethane (Tris) and hydrochloric acid (HCl, 36.5–38.0%) were obtained from Sigma (St. Louis, MO). OliGreen (OG) was obtained from Molecular Probes (Portland, OR). Note that the manufacturer did not provide the concentration of OG. The dye was diluted 100-fold with 10 mM Tris-HCl (pH 7.4) solution prior to use. All of the other salts and reagents used in this study were purchased from Aldrich (Milwaukee, WI).

Fluorescence detection of K^+. Aliquots (0.5 mL) of 10 mM Tris-HCl (pH 7.4) solutions containing OG (0.01X) and ATP-binding Apt (50 nM) in the presence of KCl (0–5.0 μM) were equilibrated at room temperature for 10 min. All solutions were then transferred into 1.0-mL quartz cuvettes and their fluorescence spectra were recorded using a Cary Eclipse fluorescence spectrophotometer (Varian, CA, USA) operated at an excitation wavelength of 480 nm.

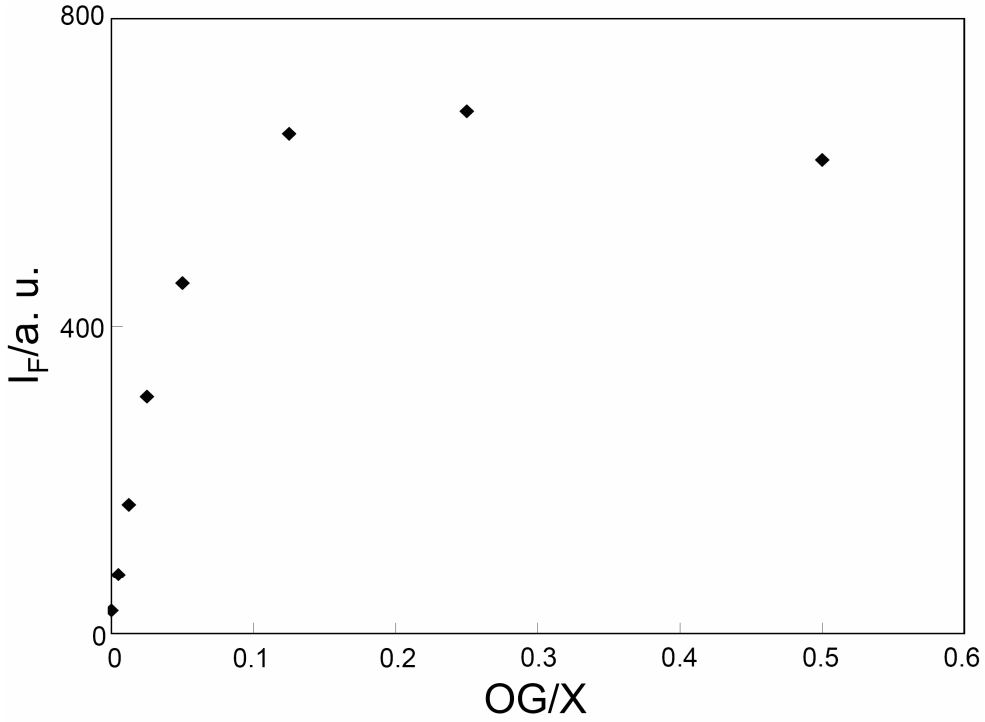

Fig. S1 Plot of fluorescence intensity of the OG·Apt complex (50 nM) against the concentration of OG (0–0.5X). Solution: 10 mM Tris-HCl, pH 7.4; excitation wavelength: 480 nm.

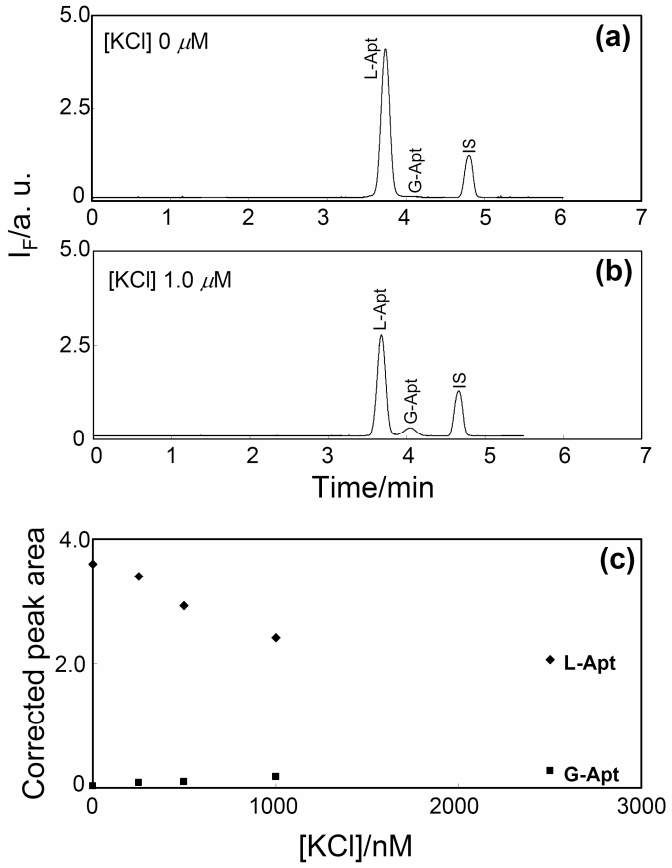

Fig. S2 Capillary electrophoresis traces (laser-induced fluorescence detection) of ATP-binding Apt (50 nM) in the (a) absence and (b) presence of 1.0 μM KCl. (c) Calibration curve constructed from analyses of samples containing 50 nM Apt at various concentrations of KCl (0–2500 nM). The separating electrolyte was 10 mM Tris-HCl (pH 7.4) containing 0.01X OG and various concentrations of KCl (0–2500 nM). Samples were prepared in a separating solution that contained final concentrations of 50 nM Apt and 10 nM fluorescein (internal standard; IS). The samples were injected into the capillary (total length, 40 cm; effective length, 30 cm) hydrodynamically (Δh = 7.5 cm) for 10 s and then an electric field of 250 V/cm was applied to effect separation. Peak areas of the signals for the linear and G-quadruplex OG-complexes were corrected for variations in injection volumes by dividing by the corresponding area of the internal standard peak.

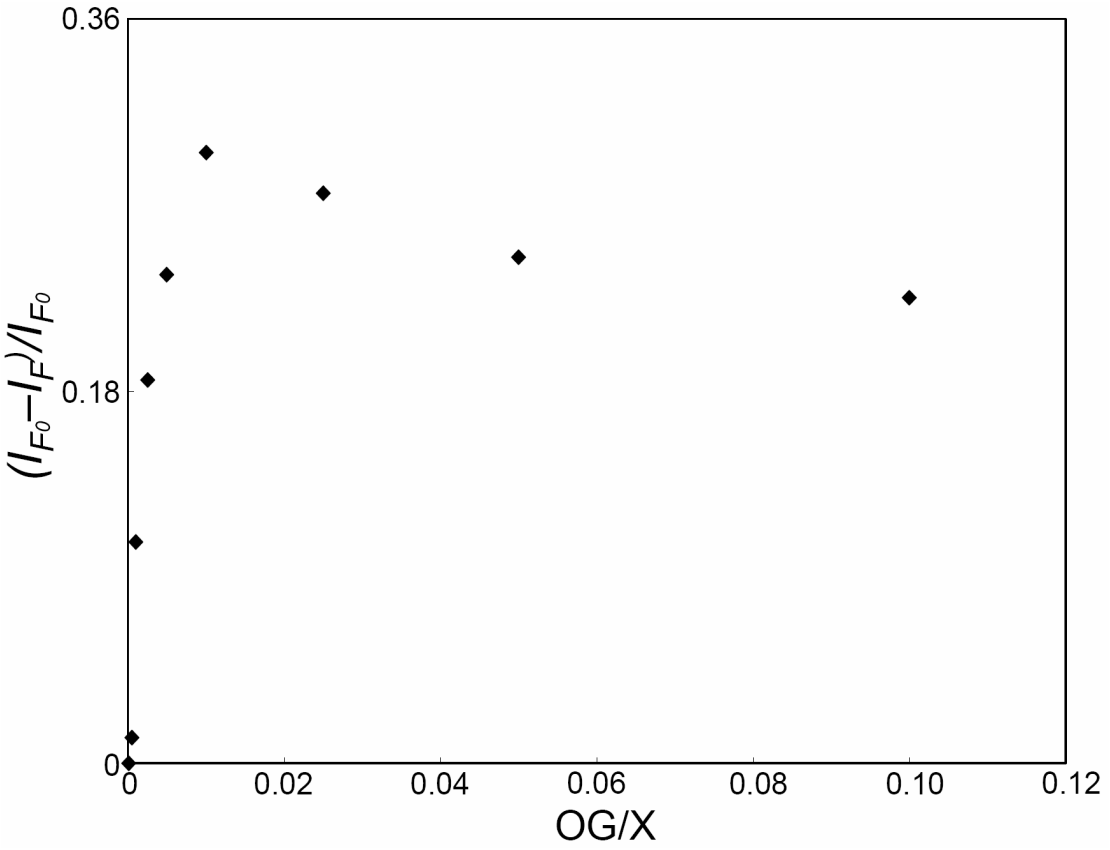

Fig S3 Effect of the concentration of OG on the value of $(I_{F0} - I_F)/I_{F0}$ of OG·Apt complexes at 520 nm in Tris-HCl solutions (10 mM, pH 7.4) in the presence and absence of K^+ (10 μM). I_{F0} and I_F are the fluorescence intensities of the OG·Apt complex in the absence and presence of K^+, respectively. Other conditions were the same as those described in Fig. 1.

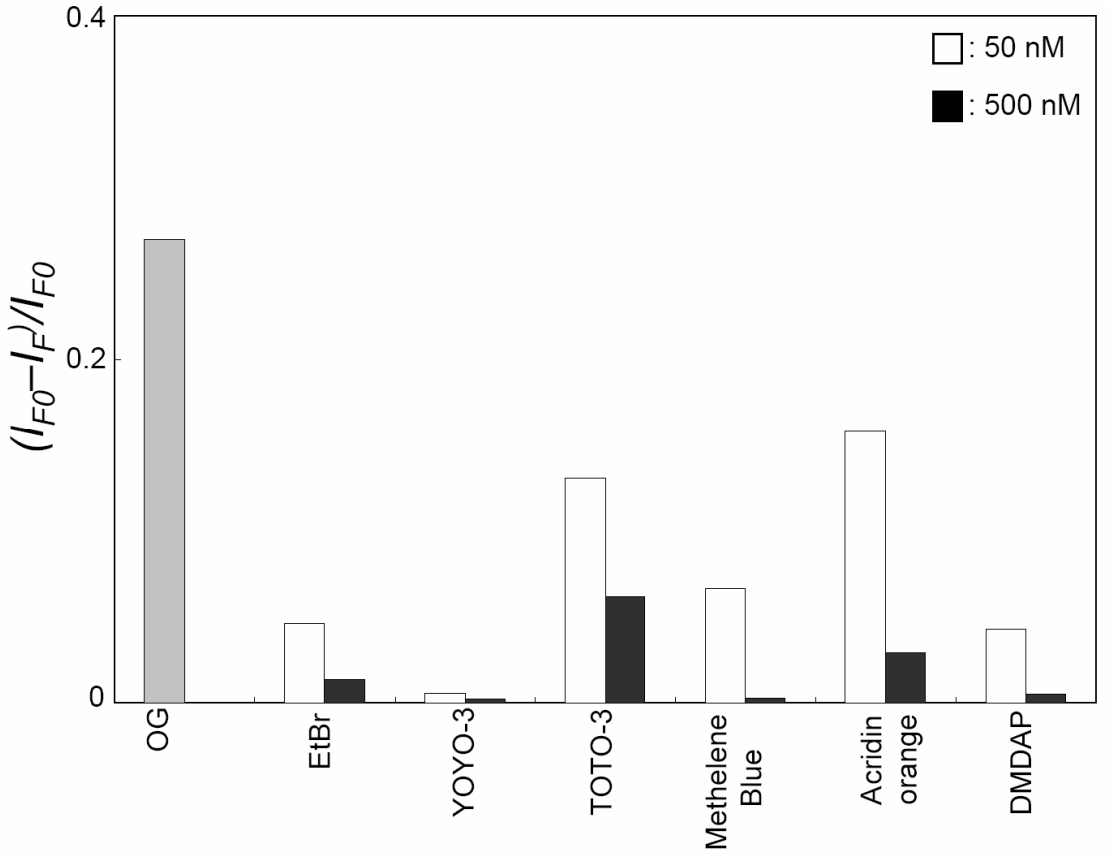

Fig. S4 Fluorescence signal decrease ratios ($(I_{F0} - I_F)/I_{F0}$) of DNA complexes in the presence of various dyes or the OG·Apt complex following the addition of K^+ (10 μM). The concentrations of OG and Apt were 0.01X and 50 nM, respectively. The concentrations of the other dyes (EtBr, YOYO-3, TOTO-3, methylene blue, acridin orange, and DMDAP) were either 50 (□) or 500 nM (■). Other conditions were the same as those described in Fig. S1.

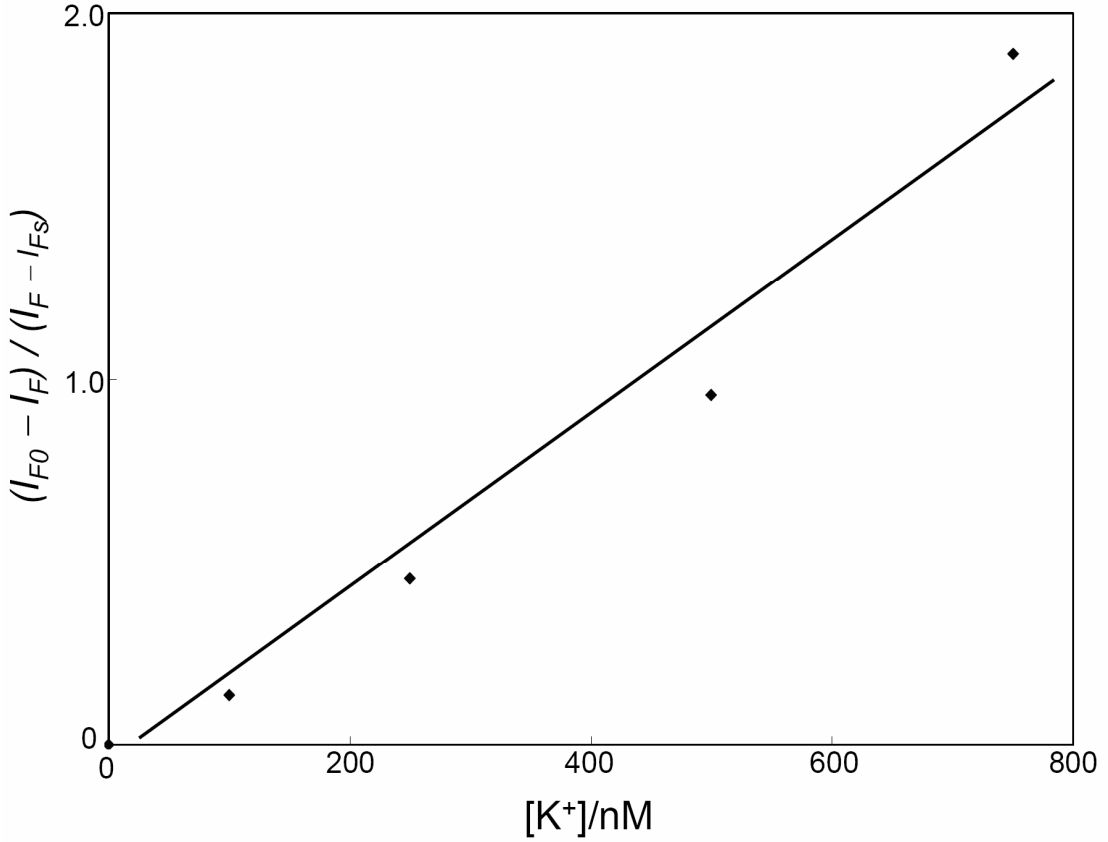

Fig. S5 Fluorescence titration of the OG·Apt complex (50 nM) with KCl (0–750 nM). The concentration of OG was 0.01X. Solution: 10 mM Tris-HCl (pH 7.4). I_{F0}, I_F, and I_{Fs} denote the fluorescence intensities of OG·Apt solutions in the absence and presence of KCl and in the presence of an excess of KCl (saturation), respectively. Plotting $(I_{F0} - I_F)/(I_F - I_{Fs})$ against the concentration of KCl (C_{KCl}) allows determination of the binding constant (K_b) for the interaction of the OG·Apt complex with K^+, on the basis of the equation $(I_{F0} - I_F)/(I_F - I_{Fs}) = K_b \times C_{KCl}$. Other conditions were the same as those described in Fig. 2.

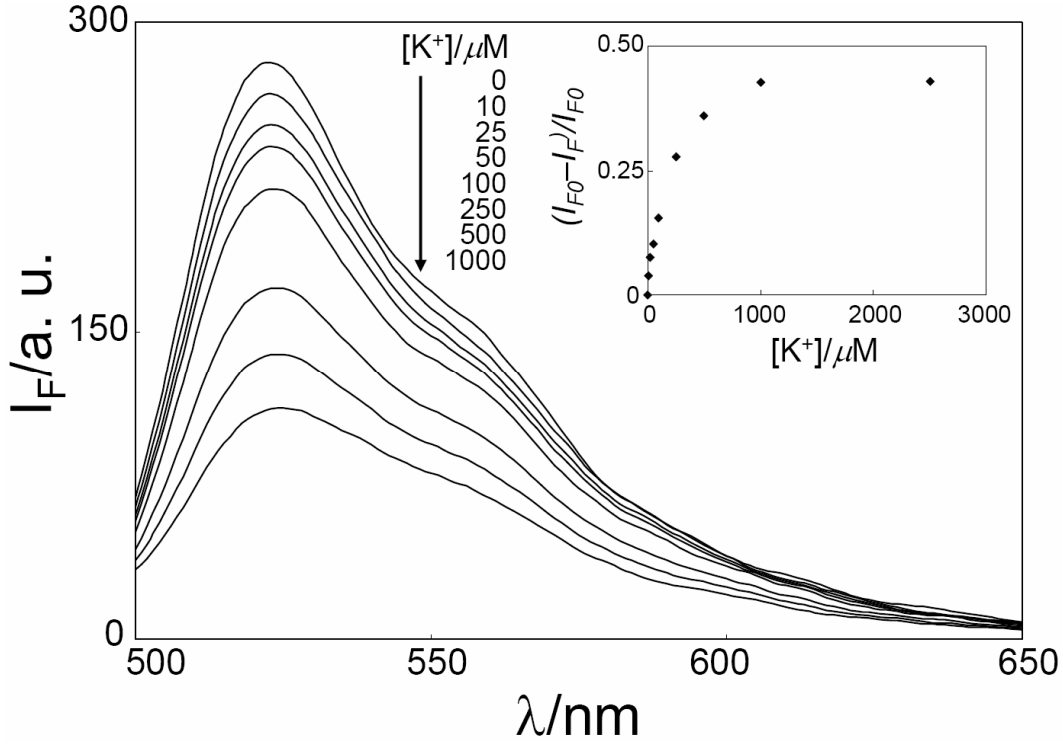

Fig. S6 Fluorescence response of the OG·oligonucleotide (human telomere sequence $[dG_3(T_2AG_3)_3]$) complex (50 nM) upon addition of K^+ ions (0-1000 μM) in Tris-HCl solution (10 mM, pH 7.4). I_{F0} and I_F are the fluorescence intensities of the OG·oligonucleotide complex in the absence and presence of K^+ ions, respectively. Inset: plotting $(I_{F0} - I_F)/I_{F0}$ against the concentration of KCl. Other conditions were the same as those described in Fig. 2.

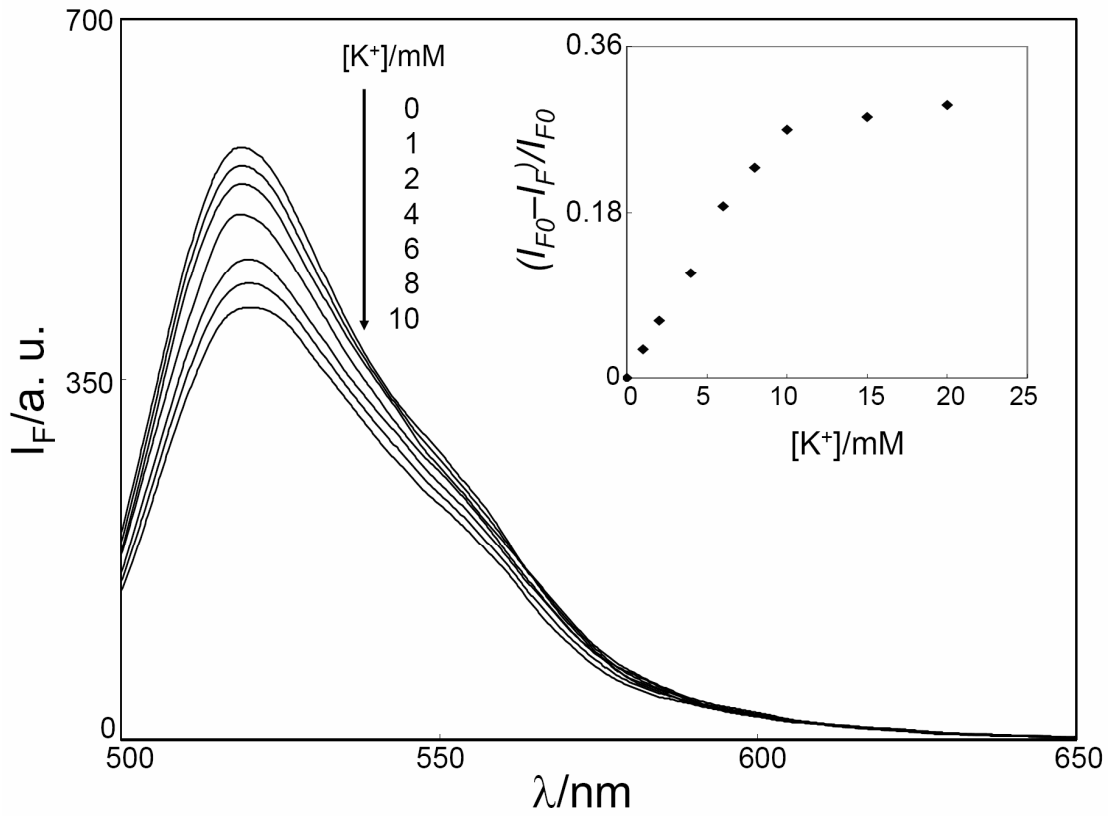

Fig. S7 Fluorescence titration spectra of the OG·Apt complex (50 nM) in the presence of KCl (0–10 mM) in Tris-HCl solution (10 mM, pH 7.4) containing 145 mM Na^+, 1.5 mM Mg^{2+}, and 2.5 mM Ca^{2+}. Other conditions were the same as those described in Fig. 2.