



Nanoparticle, Nanowire & Nanotube

Representative nanoparticle compositions and sizes

Particle composition	Available particle size [nm]
Metals	
Au	2–150
Ag	1–180
Pt	1–20
Cu	1–150
Semiconductors	
CdX (X = S, Se, Te)	1–20
ZnX (X = S, Se, Te)	1–20
PbS	2–18
TiO ₂	3–50
ZnO	1–30
GaAs, InP	1–15
Ge	6–30
Magnetic	
Fe ₃ O ₄	6–40
Polymer	
Many compositions	50–1000

Size- and shape-dependent light scattering property

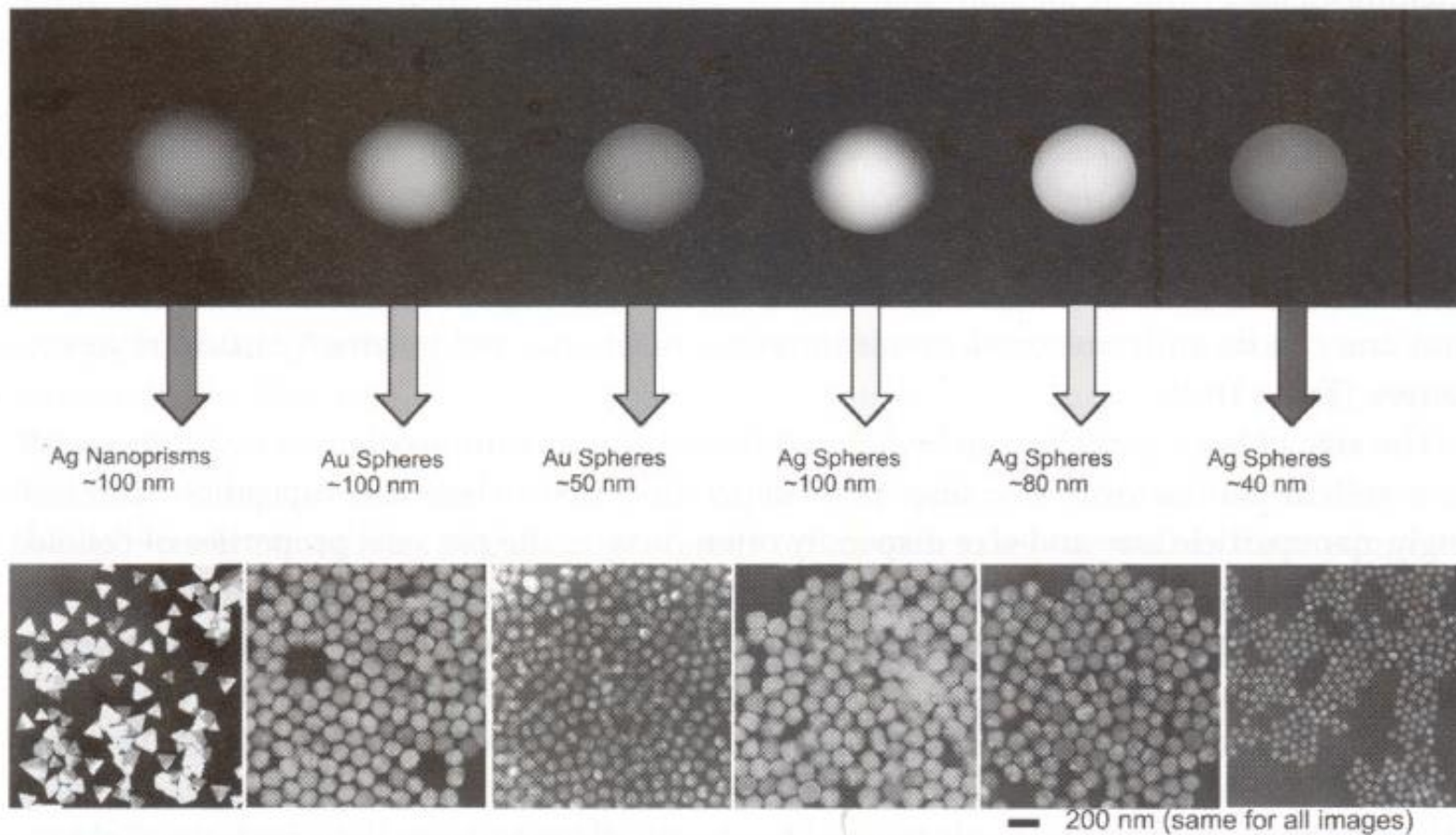
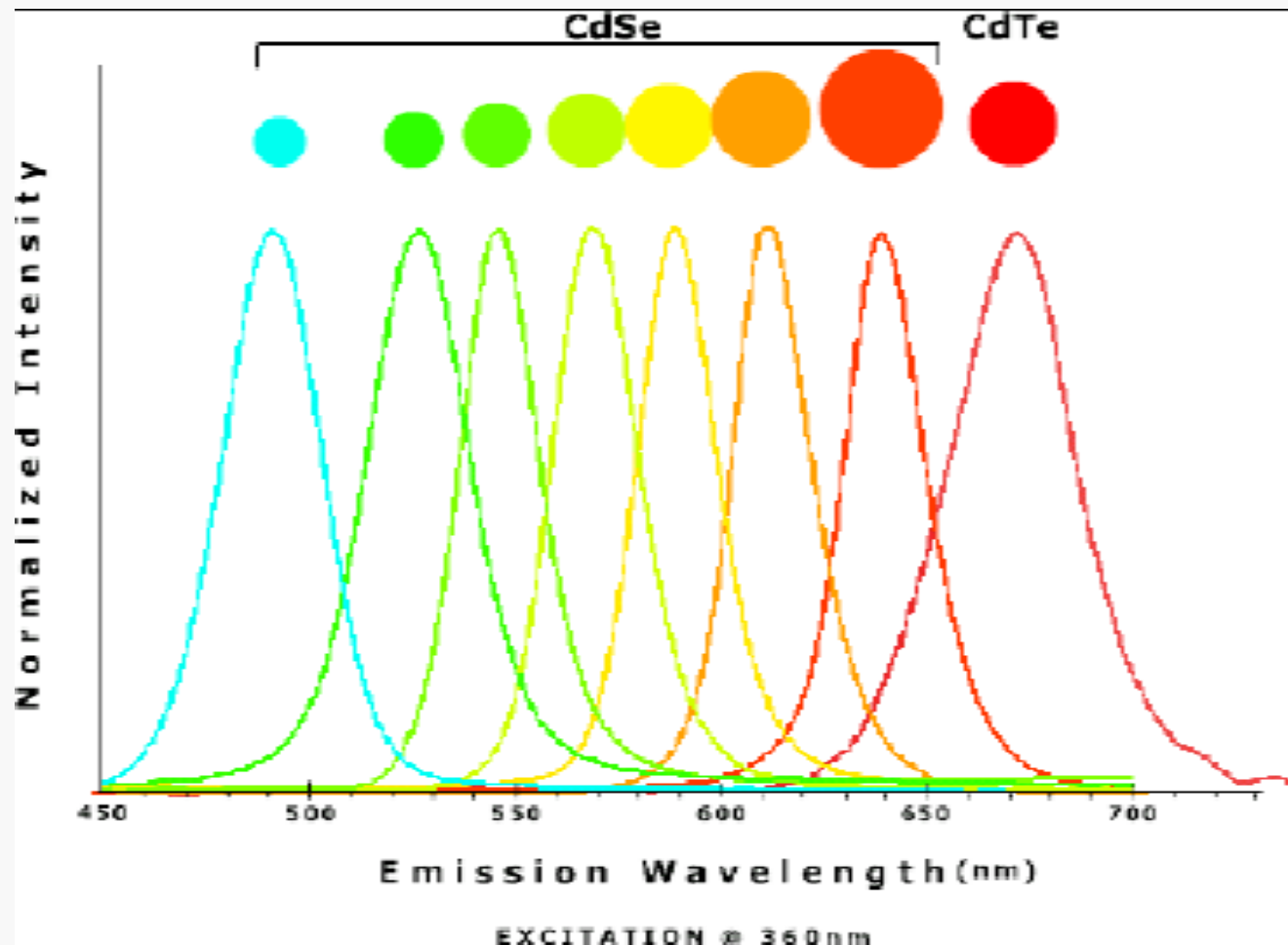
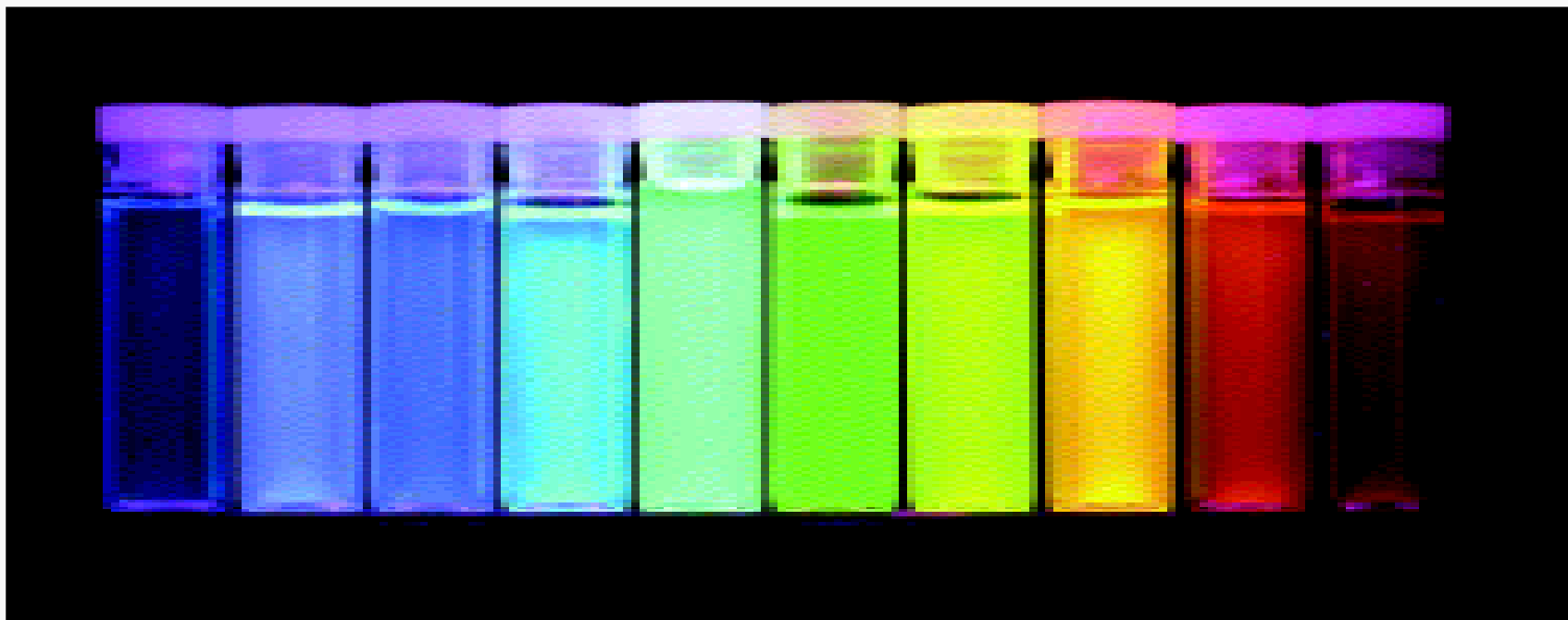


Figure 19.1 Size- and shape-dependent light scattering by representative silver and gold nanoparticles with corresponding transmission electron microscopic (TEM) images of the particles.

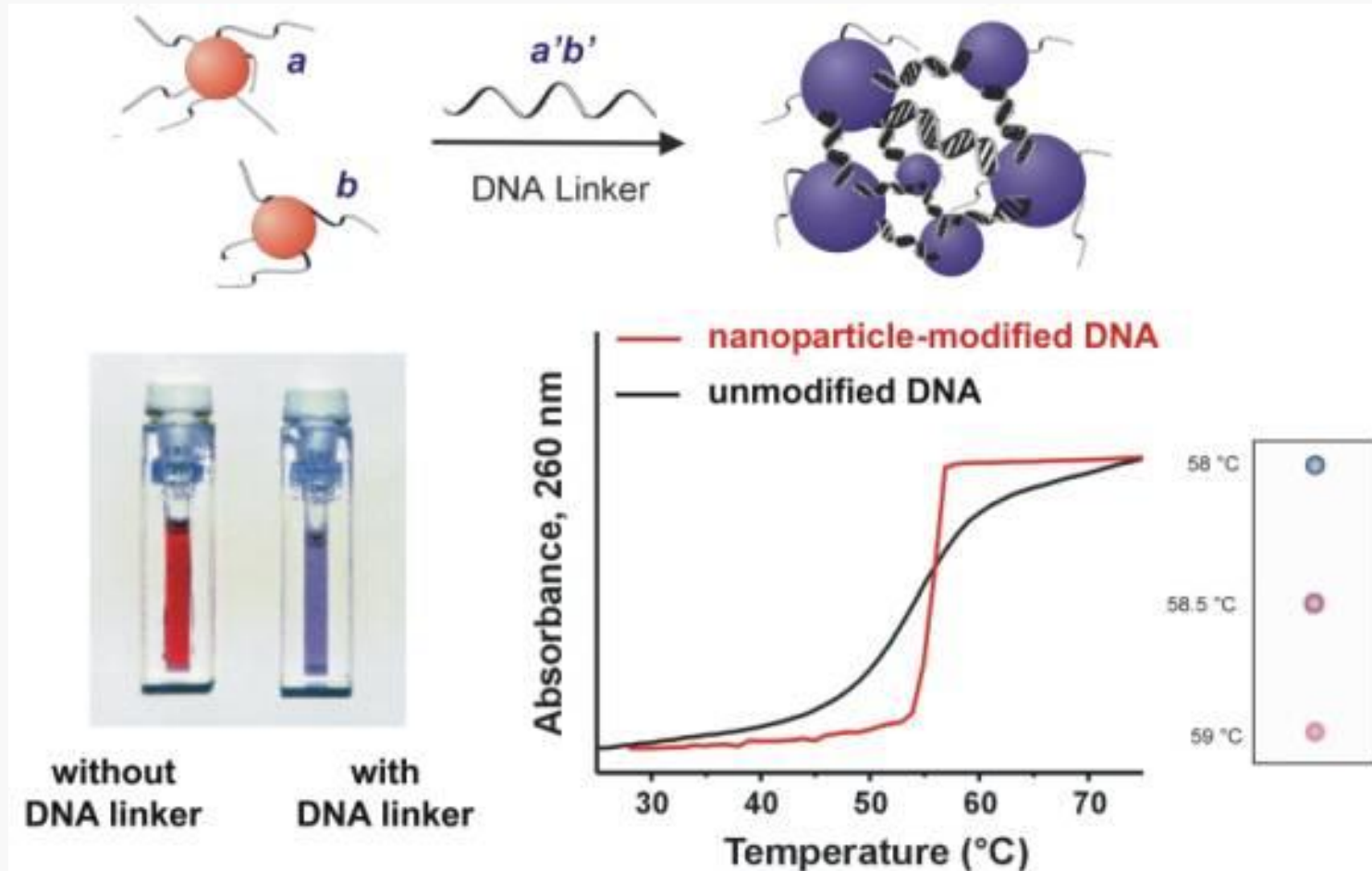
Quantum dots yield size-tunable emission.



Emission colors of CdSe/ZnS core/Shell Quantum dots



DNA-functionalized Gold Nanoparticles



Thermal denaturation profiles

Nanowire

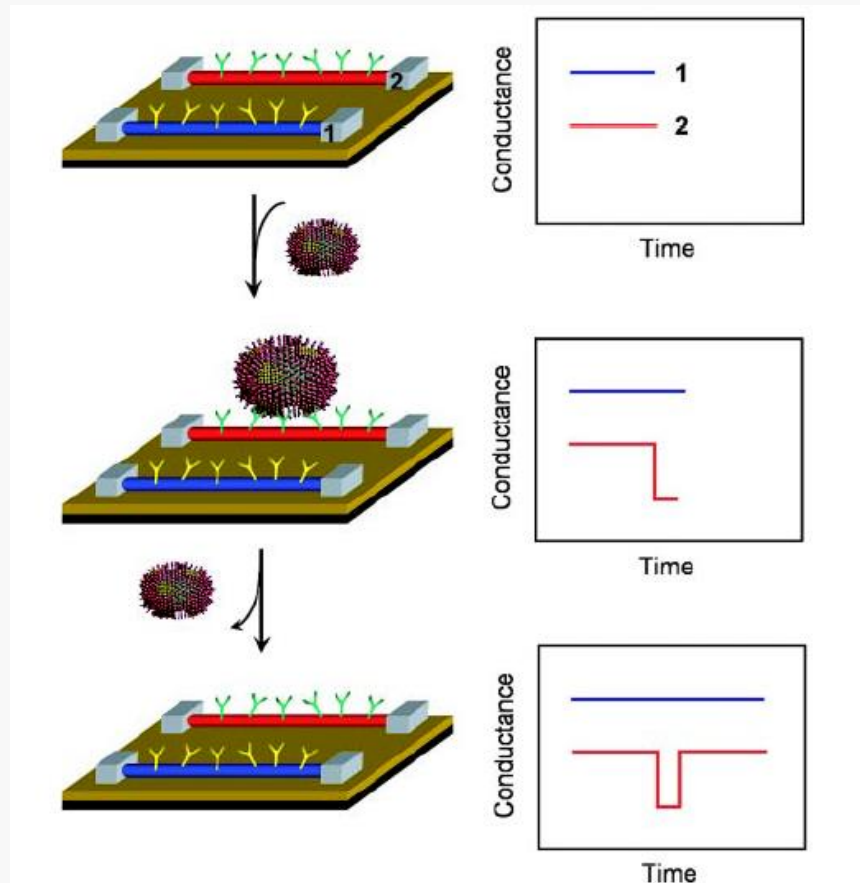
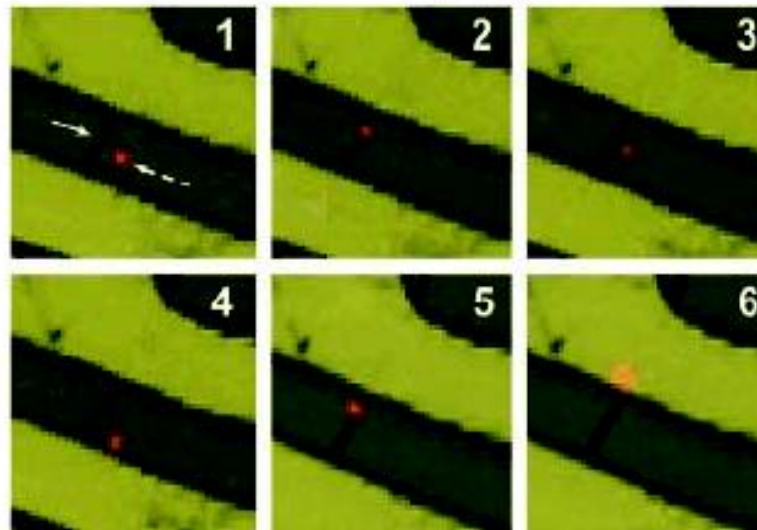
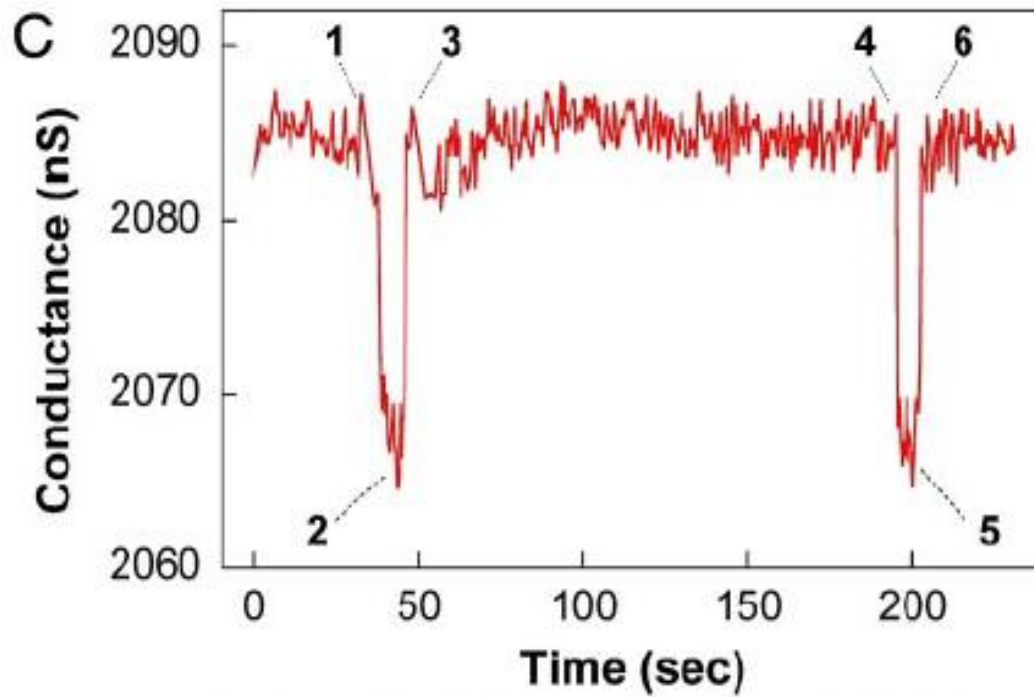


Fig. 1. Nanowire-based detection of single viruses. (*Left*) Schematic shows two nanowire devices, 1 and 2, where the nanowires are modified with different antibody receptors. Specific binding of a single virus to the receptors on nanowire 2 produces a conductance change (*Right*) characteristic of the surface charge of the virus only in nanowire 2. When the virus unbinds from the surface the conductance returns to the baseline value.

(PNAS, 101,
14017, 2004)



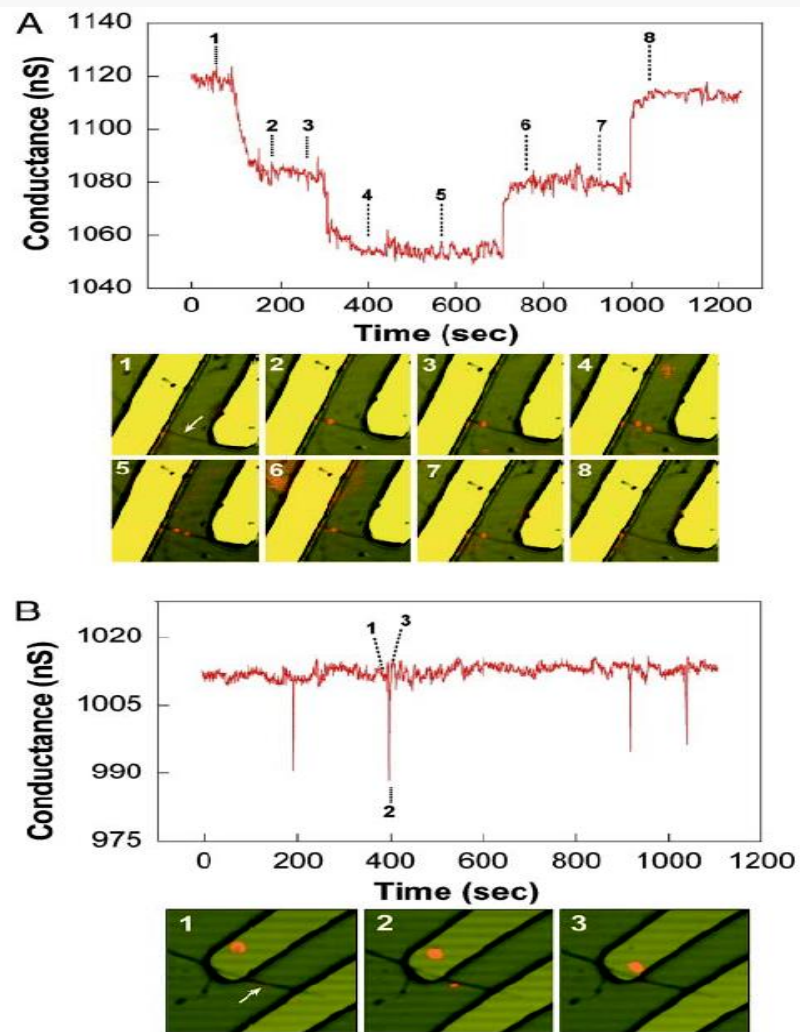
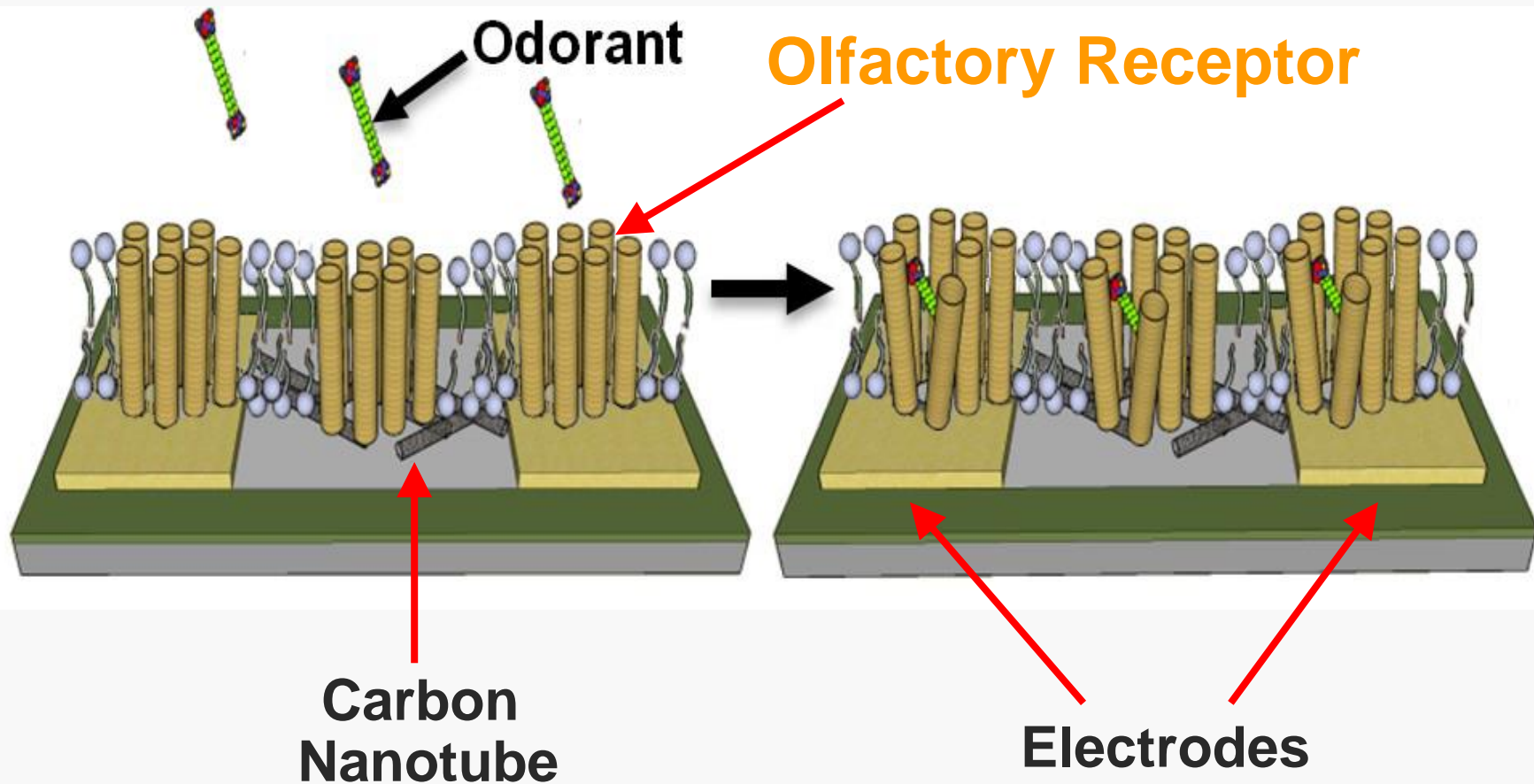


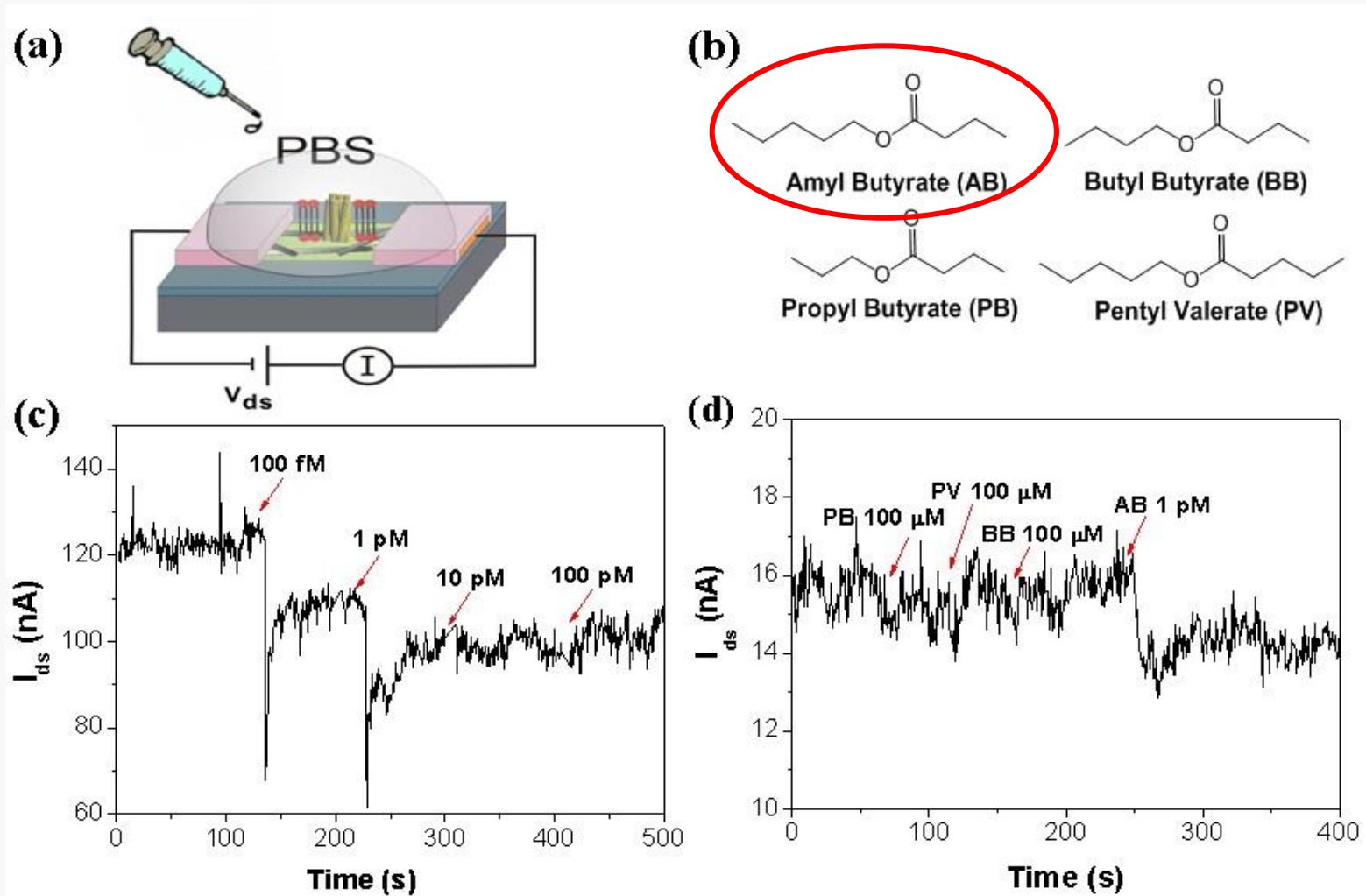
Fig. 4. Single virus binding selectivity. (A) Simultaneous conductance and optical vs. time data recorded from a single nanowire device with a high density of anti-influenza type A antibody. Influenza A solution was added before point 1, and the solution was switched to pure buffer between points 4 and 5 on the plot. The bright-field and fluorescence images corresponding to time points 1–8 are indicated in the conductance data; the viruses appear as red dots in the images. Each image is $6.5 \times 6.5 \mu\text{m}$. (B) Simultaneous conductance and optical vs. time data recorded from a single nanowire device with a low density of anti-influenza type A antibody. Bright-field and fluorescence images corresponding to time points 1–3 are shown. Each image is $7 \times 7 \mu\text{m}$. Measurements were made by using solutions containing 100 viral particles per μl . The solid white arrows highlight the positions of the nanowires in both devices.

Carbon Nanotube



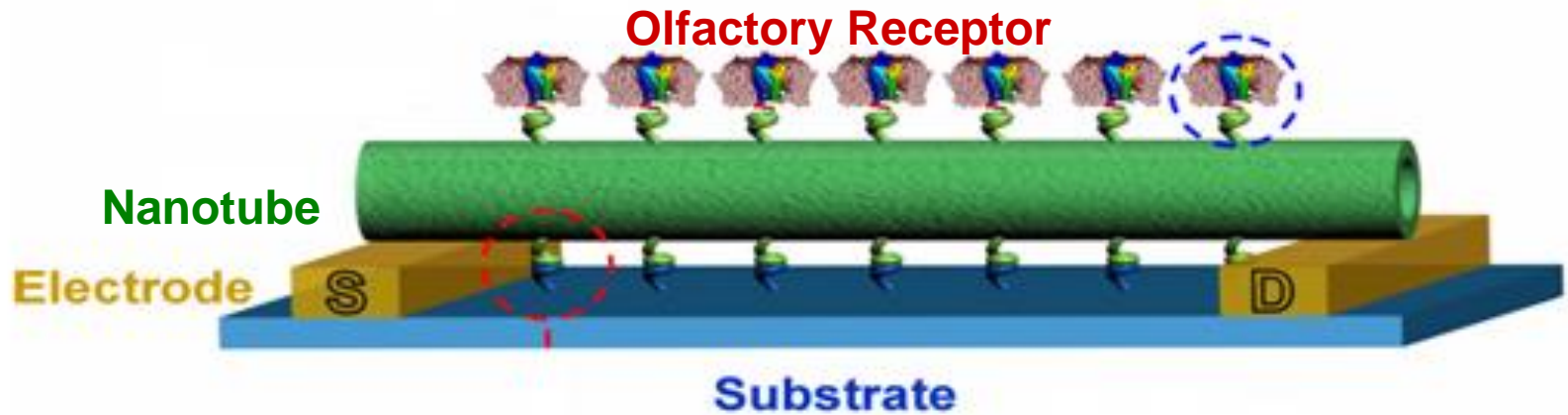
Kim et al., Advanced Materials, 21, 91-94 (2009)

Current Change



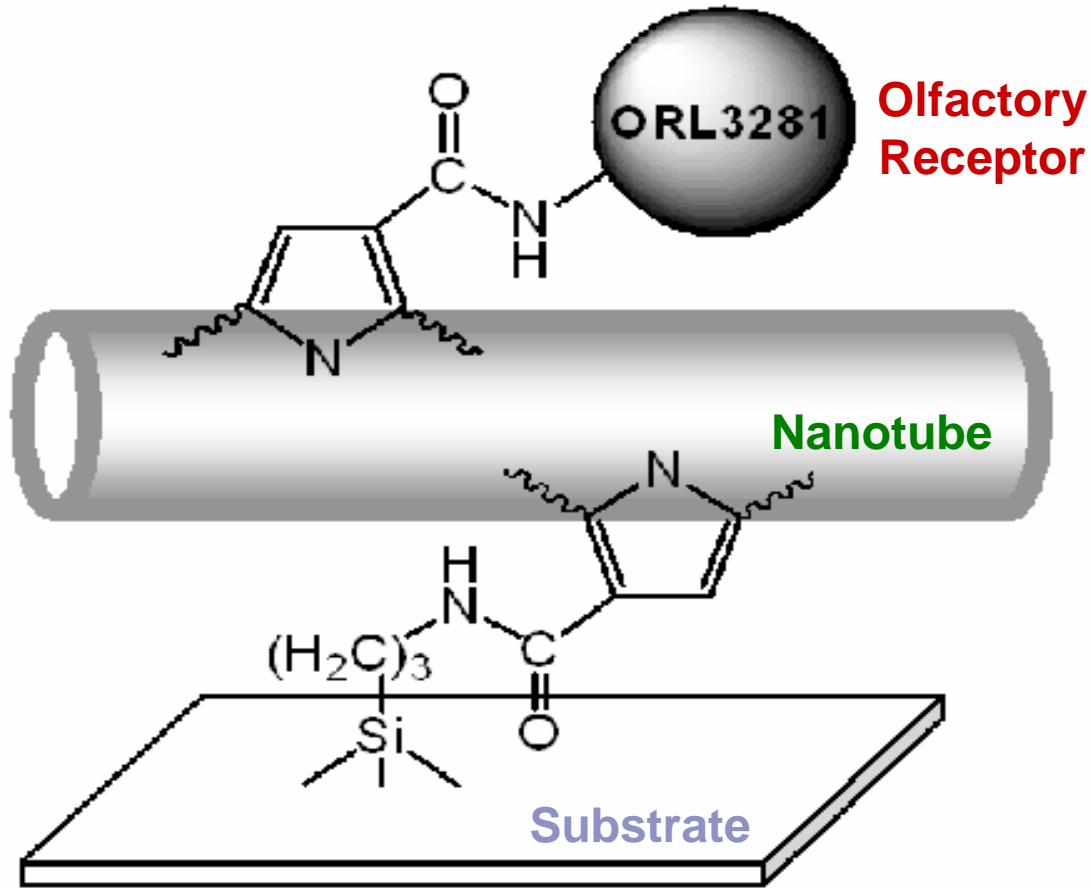
Kim *et al.*, *Advanced Materials*, 21, 91-94 (2009)
Highlighted by Nanowerk (2009)

Conducting Polymer Nanotube

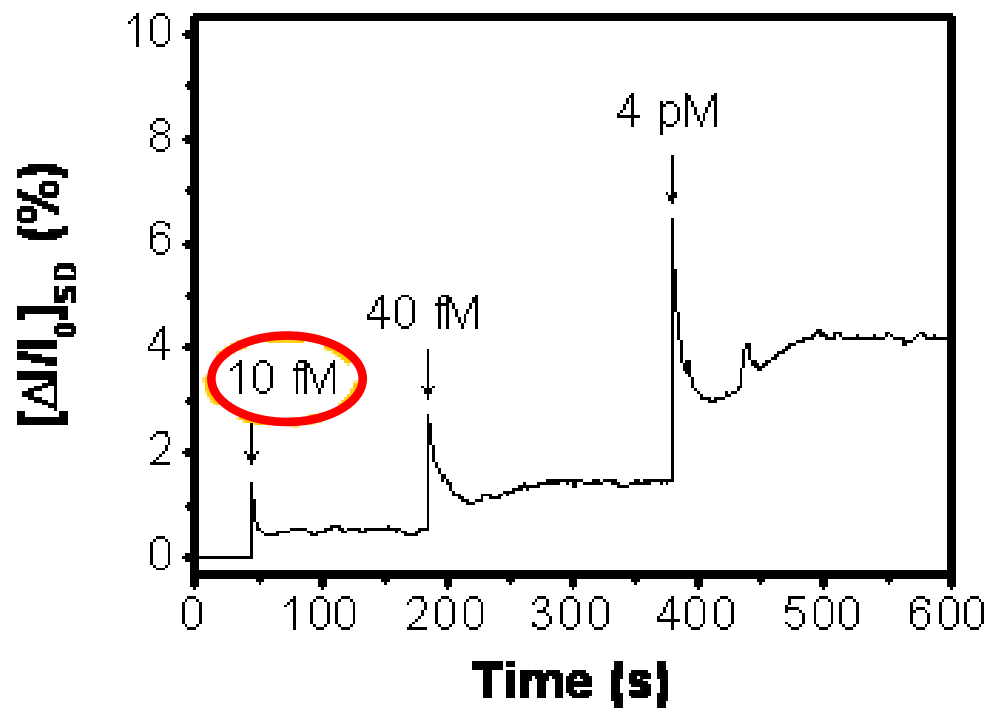


Yoon *et al.*, *Angewandte Chemie*, 48, 2755-2758 (2009)

Receptor Covalently Bonded on Nanotube



Sensitivity

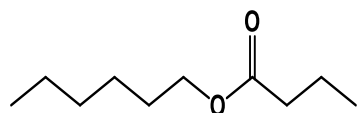


Yoon *et al.*, *Angewandte Chemie*, 48, 2755-2758 (2009)

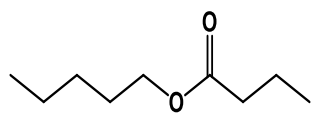
Featured highlight, *npg asia materials*, *Nature asia-pacific* (2009)

Highlighted by *Chemistry World*, *Royal Society of Chemistry*, UK (2009)

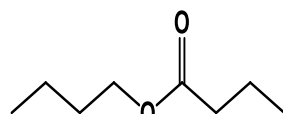
Selectivity



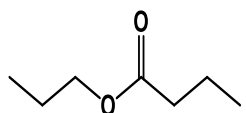
Hexyl Butyrate (HB)



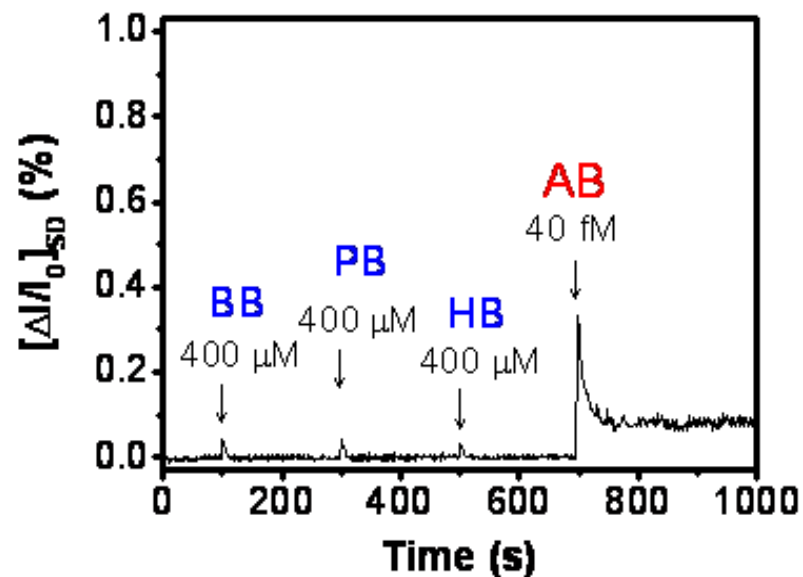
Amyl Butyrate (AB)



Butyl Butyrate (BB)



Propyl Butyrate (PB)

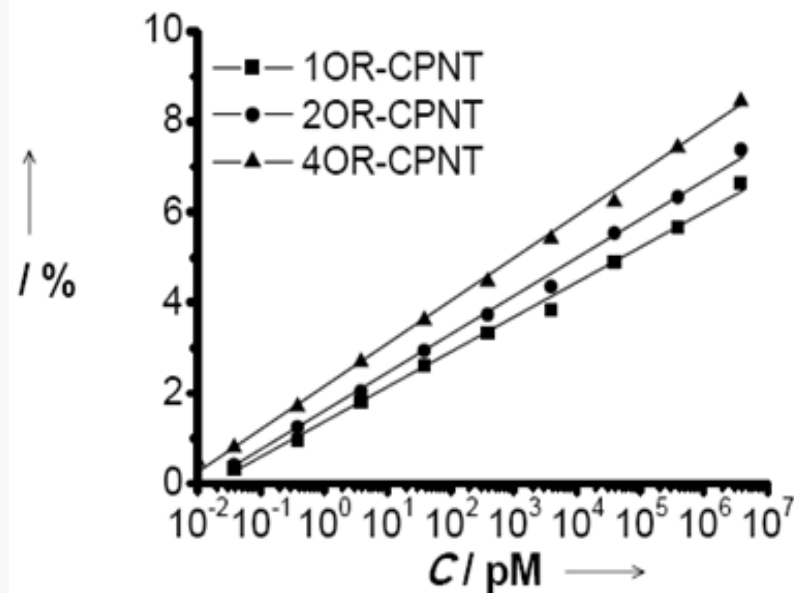
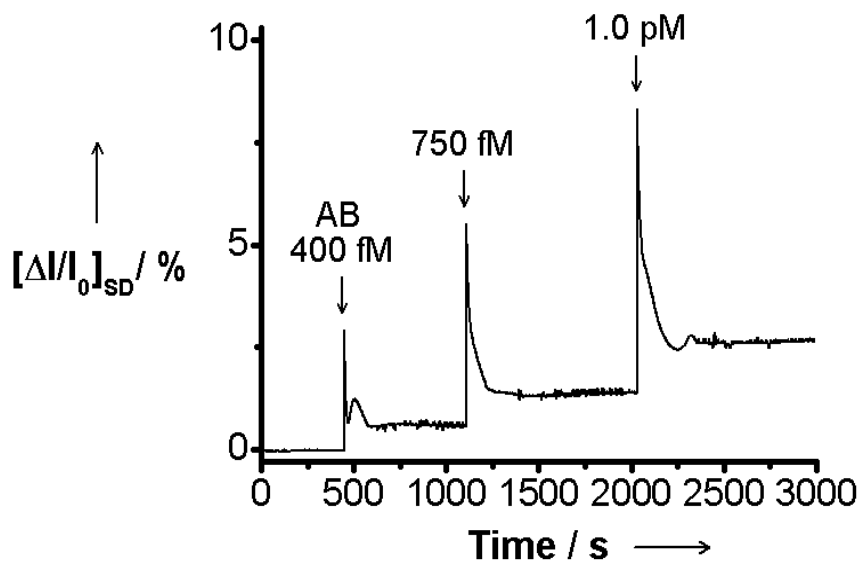


Yoon *et al.*, *Angewandte Chemie*, 48, 2755-2758 (2009)

Featured highlight, *npg asia materials*, *Nature asia-pacific* (2009)

Highlighted by *Chemistry World*, *Royal Society of Chemistry*, UK (2009)

Dose-Dependent Relationship



Yoon *et al.*, *Angewandte Chemie*, 48, 2755-2758 (2009)

Featured highlight, *npg asia materials*, *Nature asia-pacific* (2009)

Highlighted by *Chemistry World*, Royal Society of Chemistry, UK (2009)