# Supporting information

## Highly sensitive colorimetric detection of Cd(II) based on silica sol modified with dithizone and cationic surfactant

Arpaporn Litluechai[a], Arreerat Prompa[a], Pikaned Uppachai[b], Wirat Jarernboon[c]
Nutthaya Butwong[d], Siriboon Mukdasai[a*]

[a] *Materials Chemistry Research Center, Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand*

[b] *Department of Applied Physics, Faculty of Engineering, Rajamangala University of Technology Isan, Khon Kaen Campus, Khon Kaen 40000, Thailand*

[c] *Department of Physics, Faculty of Science, Khon Kaen University, Meuang, Khon Kaen, 40002, Thailand*

[d] *Applied Chemistry Department, Faculty of Science and Liberal Arts, Rajamangala University of Technology Isan, Nakhon Ratchasima 30000, Thailand*

* Corresponding author: E-mail address: sirimuk@kku.ac.th (S. Mukdasai)

**1. Effects of pH and time**

The pH of the aqueous solution plays a key role in the speciation of chelating agents, complex formation, and extraction efficiency. Here, complex formation between DZ and $Cd^{2+}$ was investigated in the pH range of 2.0–6.0 using different buffer solutions (0.1 mol $L^{-1}$ phosphate buffer and acetate buffer). As shown in **Fig. S1A**, the [$Cd^{2+}$-DZ] complex solution achieved maximum absorbance at pH 3.0 and a slightly lower absorbance at higher pH. Therefore, the phosphate buffer at pH 3.0 was selected for further experiments.

To study stability of the [$Cd^{2+}$-DZ] complex, its absorbance was monitored for 50 min. The absorbance increased during the first 30 min and then decreased slightly (**Fig. S1B**). Thus, in the subsequent experiments, the detection of $Cd^{2+}$ was carried out at 30 min after mixing.

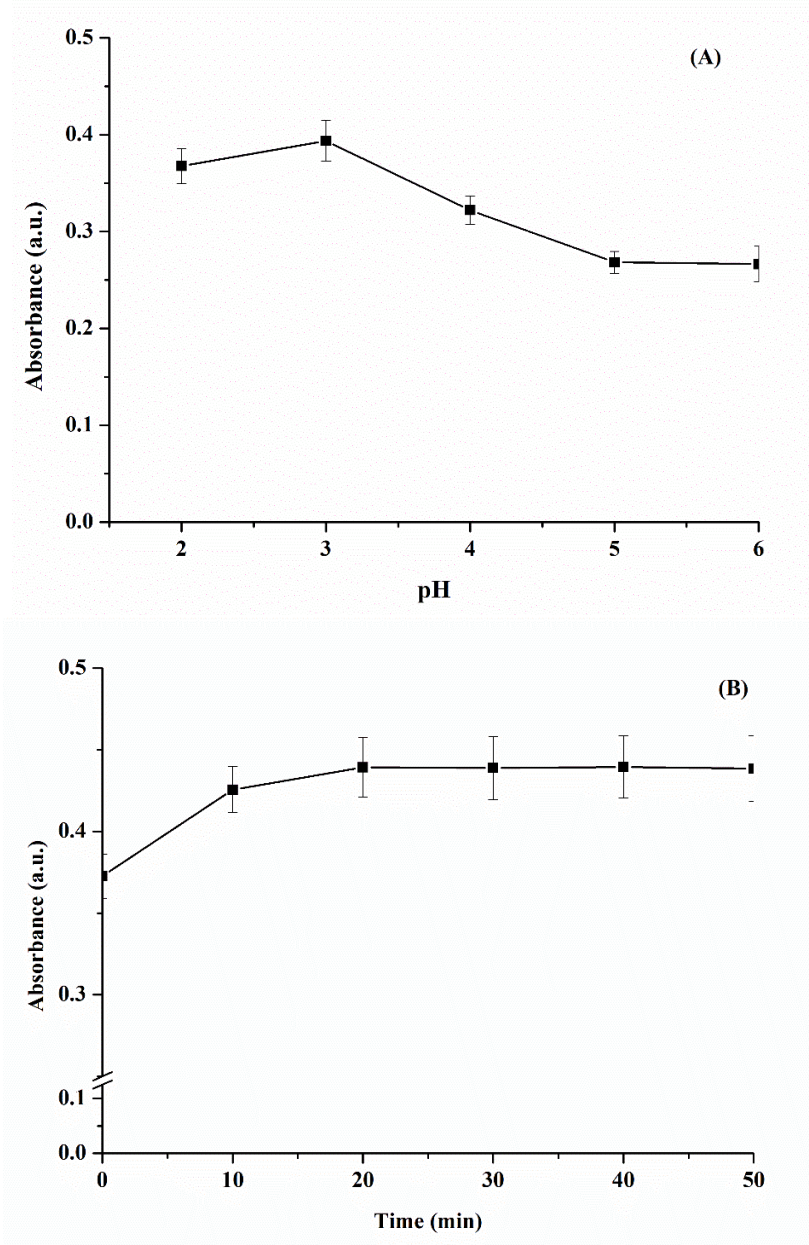


**Fig. S1** Effects of (A) pH and (B) time on the formation of the [$Cd^{2+}$-DZ] complex.

## 2. Characterization of the silica sol

The functional group of silica sol, and silica particles was studied by fourier transformed infrared (FT-IR) analysis as the result shown in **Fig. S2**. It can be seen that all spectra found broad band at 3200–3750 $cm^{-1}$ assigning OH-stretching of silanol. Moreover, the O–H deformation of $H_2O$ (~1630 $cm^{-1}$) and Si–O–Si stretching (~1100 $cm^{-1}$) were observed. In addition, silica sol shows Si–OH stretching of silanols on surface at 960 $cm^{-1}$. Therefore, it can be confirmed that the silica sol was successfully synthesized.

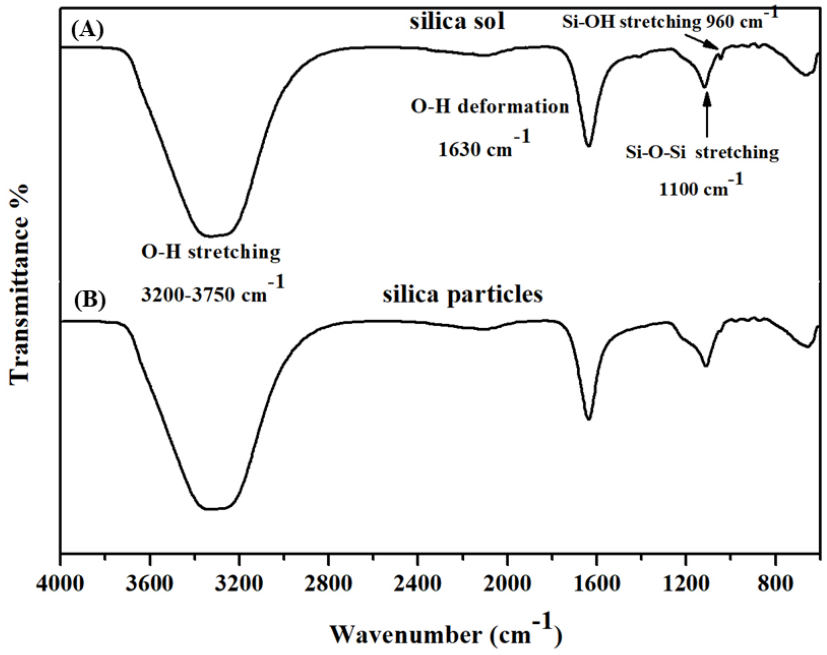


**Fig. S2** FT-IR spectra of the (A) silica sol and (B) silica particles.

### 3. Formation of $Cd^{2+}$ complex

To investigate the stoichiometry of $Cd^{2+}$ and DZ, job's method or continuous variation analysis was carried out. The results indicated that the optimum ratio of $Cd^{2+}$ and DZ was 1:1 stoichiometry **(Fig. S3)**. When $Cd^{2+}$ interacted with DZ, the colored solution was changed from purple to orange which has complex formation constant (log $K_f$) of 3.36 and maximum absorption wavelength of 435 nm [36,37].

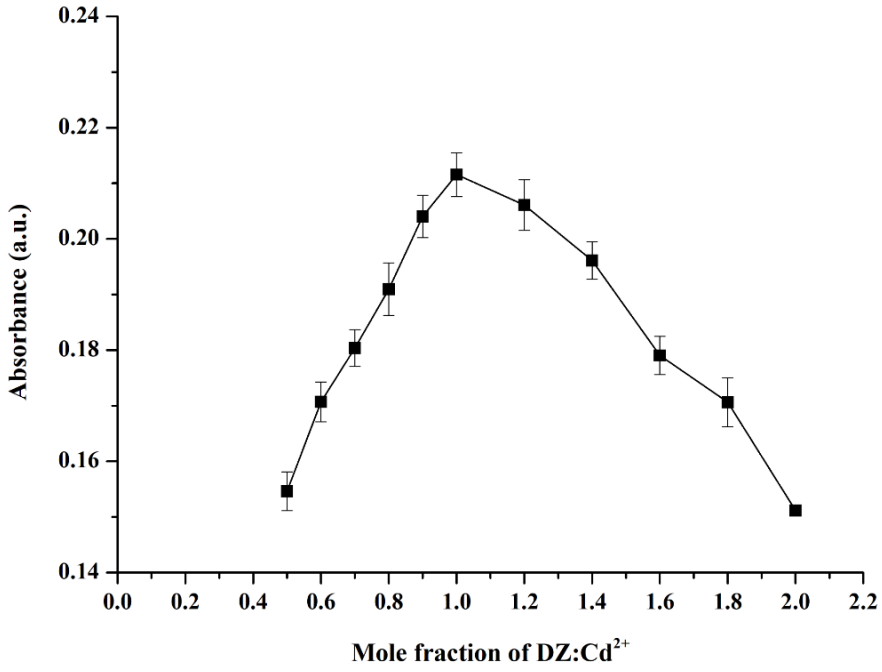


**Fig. S3** Stoichiometry of $Cd^{2+}$ and DZ using job's method.