Emission properties of $[Au(CN)_2]^-$ oligomers with cationic surfactants

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$[Au(CN)_2]^-$ forms emissive oligomers due to aurollophilic interaction. The wavelength of the emission peak of the oligomers depends on the degree of oligomerization in aqueous solutions: 330 nm for the dimer, 390 nm for the trimer, and 430 nm for the tetramer [1]. Recently, we found that the emission quantum yields are considerably increased by adding tetraethylammonium cations to the solutions. [2]. In this study, we investigated the emission properties of aqueous solutions of $[Au(CN)_2]^-$ and cationic surfactants with a long alkyl chain (TTA^+, HTA^+, and STA^+, Fig.1).

Aqueous solutions of $[Au(CN)_2]^-$ (1.0 mM) containing cationic surfactants (1.0 mM) showed emission peaks at 470 – 480 nm (Fig.2). Since the peak wavelength is longer than 430 nm, the 470-480-nm emission is originated by an excited pentamer and/or larger oligomers generated in solutions. In addition, the aqueous solutions containing STA^+ exhibited emissions with significantly longer lifetimes and higher emission quantum yields compared with those containing TTA^+ and HTA^+(Table 1). The emission quantum yield of 1.0 mM $[Au(CN)_2]^-$ aqueous solutions containing 1.0 mM STA^+ is 0.56 (Table 1), though $[Au(CN)_2]^-$ solutions containing 1.0 mM tetraethylammonium cation show little or no emission. In aqueous solutions of cationic surfactants such as STA^+, molecular aggregates are formed by hydrophobic interaction between the cationic surfactants. A high-density positive charge of the aggregates would markedly stabilize excited-state oligomers of $[Au(CN)_2]^-$ and thereby increase the lifetime and emission quantum yields.

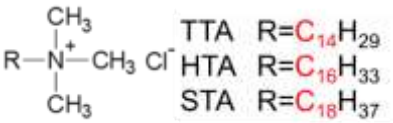

Figure1. Cationic surfactants

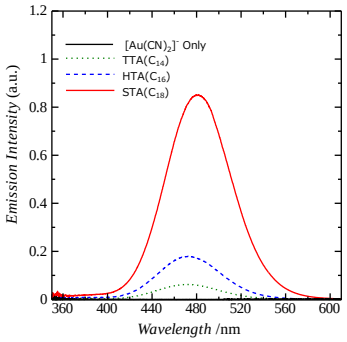

Figure2. Emission spectra of $[Au(CN)_2]^-$ (1.0 mM) and cationic surfactants(1.0 mM)aqueous solutions (λ_{ex} = 310 nm)

Table1 Peak wavelength (λ_{ex}=310 nm), emission lifetime($\tau_{ave.}$) (λ_{ex} =337 nm) and quantum yields (Φ_{em}) for aqueous solutions of $[Au(CN)_2]^-$ (1.0 mM) containing cationic surfactants(1.0 mM)

Cationic Surfactants	λ_{em} /nm	$\tau_{ave.}$ /ns	Φ_{em}
TTA(1.0 mM)	470	210	0.20
HTA(1.0 mM)	470	213	0.22
STA(1.0 mM)	480	810	0.56

[1] M. Iwamura *et al., Phys. Chem. Chem. Phys.*, **2016**, 18, 5103.
[2] R. Wakabayashi *et al., Inorg. Chem.,* **2016**, 55, 7739−7746.