

Trinuclear Copper(I) Pyrazolate Complexes for Vapochromic Sensing of Aromatic Volatile Organic Compounds

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ABSTRACT

Vapochromism using optical chemosensors of d^{10} group metal complexes have a great potential for sensing different kinds of volatile organic compounds (VOCs) by vapor-triggered color and luminescence changes. Since organic aromatic vapors are mainly hazardous and carcinogenic to human health and environment, it is interesting challenge to develop the low-cost vapochromic chemosensors with high sensing capability. On the other hands, inorganic complexes and materials have been found to change their color and luminescence properties by modifying molecular structures. However, there is no study on, the relationship of molecular structures for chemosensors of VOCs such as aromatic vapors. Therefore, we report systematic study on by using supramolecular assembly of a weak metal-metal interaction, optical response of trinuclear copper(I) pyrazolate complexes ($[Cu_3Pz_3]$) for vapochromic chemosensors of benzene, toluene and hexafluorobenzene. The $[Cu_3Pz_3]$ complexes have been successfully synthesized from 3,5-dimethyl (complex **A**), 3,5-trifluoromethyl (complex **B**), 3,5-diphenyl (complex **C**) and 4-(3,5-dimethoxybenzyl)-3,5-dimethyl (complex **D**) pyrazole ligands as a solid powder. The resulting complexes showed color emission in the range from red to green upon exposure to a UV hand lamp (254 nm) in dark room, which were in good agreement with emission spectra upon excitation at 280 nm; 590 nm (complex **A**), 570 nm (complex **B**), 614 nm (complex **D**) and upon excitation at 321 nm for emission at 642 nm (complex **C**). The sensing capability of all $[Cu_3Pz_3]$ complexes with different molecular side-chains showed different phenomena depending on the types of aromatic solvents. In contrast to no response of complex **A** upon exposure to VOCs, complexes **B** and **C** showed gradually quenching of the intensity due to cleavage of Cu(I)-Cu(I) interaction. Interestingly, complex **D** showed blue shifting of its emission center due to enhancement of the metal-metal distance.

| Volatile organic compounds | Aromatic vapors | Luminescence | Vapochromic chemosensor | Metallophilic interactions |

Bactericidal Effect of Kaolinite Modified with Cetylpyridinium Bromide and Silver Ions against *Staphylococcus aureus* (ATCC 6538)

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ABSTRACT

Organo-silver-kaolinite (OSK) was prepared by the attachment of cetylpyridinium bromide (CPB) (50%, 300%, 1000% from Cation Exchange Capacity (CEC) of kaolinite) on silver (50% from CEC) loaded kaolinite. The kaolinite, silver-kaolinite (SK) and OSK were characterized by X-ray diffraction (XRD), energy dispersive X-ray (EDX) analyzer and Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) spectroscopy. The results showed silver-kaolinite has high affinity towards CPB molecules where the adsorption of CPB on silver-kaolinite increased with the increased CPB initial concentration. FTIR spectra of OSK showed high peaks intensity at $\sim 2850\text{ cm}^{-1}$ and $\sim 2920\text{ cm}^{-1}$ correspond to CPB molecules that attached on silver-kaolinite. XRD patterns for OSK in comparison with kaolinite showed the modification of kaolinite with silver and CPB did not change the structure of the kaolinite. Analysis through EDX spectra demonstrated the presence of silver ions in OSK. These characterizations confirmed that both antibacterial agents (silver ions and CPB) have been successfully loaded on kaolinite. The antibacterial assay of samples was carried out against *Staphylococcus aureus* species. The minimum inhibitory concentration (MIC) values of OSK (CPB-50%, 300%, 1000%) were 3, 0.7 and 0.5 mg/L, respectively while SK was 10 mg/L in distilled water. However in saline solution, the MIC values of OSK (CPB-50%, 300%, 1000%) were 3, 0.5, 0.5 mg/L, respectively and SK was $>12\text{ mg/L}$. The lower MIC values resulted in higher antibacterial activity of antibacterial agent and *vice versa*. Lower antibacterial of SK in saline solution is due to the presence of chloride ion that can react with silver ions forming silver chloride precipitate which could lower the antibacterial activity of silver that released from SK. Meanwhile, OSK shows similar antibacterial activities in both solutions. It might be due to the combination of silver and CPB play synergistic role in ions reaction and attacking the bacteria cell in the solution at one time. Based on the MIC values, OSK exhibited high antibacterial activity as compared to SK. Hence, OSK could be used as an effective antibacterial agent that can be alternative to silver based products.

| Kaolinite | Cetylpyridinium bromide | Silver ions | Antibacterial agent | *Staphylococcus aureus* |