

Comparison in Surface Enhanced Raman Scattering on Salicylideneamine between Silver and Gold Colloid and Silver Mirror Substrate

ZHAO Bing^{1*}, Yukihiro Ozaki²

1. Key Lab. for Supramolecular Structure and Spectroscopy of Ministry of Education, Jilin Univ., Changchun, 130023, China. E-mail: wqxu@mail.jlu.edu.cn;
2. School of Science, Kwansei-Gakuin Univ., Nishinomiya 662-8501, Japan; E-mail: ozaki@kwansei.ac.jp)

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Detailed abstracted: In recent years, the study of photochromic and thermochromic materials has grown because of their possible applications in the optical processing of information, in addition to the scientific interest. Salicylideneamines are one of the prospective choices owing to their photochromism caused by intramolecular hydrogen transfer^[1~3] (Fig. 1). It is generally agreed that, in the salicylideneamine system, photoexcitation is followed by a rapid barrierless proton transfer and subsequent rearrangement to form a colored photoproduct^[4]. The photochemistry of the system in fluid solution is different from that of the solid, even in fluid solution, the photo- and thermo-chromic behavior is changed with the polarity of solvent^[5,6]. Although the study on these Schiff bases has been continuing for several decades, there is no conclusion on the photochromic mechanism and the structure of the photoproduct by now.

In the present study, the surface-enhanced Raman scattering (SERS) of a series of salicylideneamine compounds (structure are shown in Fig. 2) were measured for silver and gold nanoparticles and silver mirror surface.

The 514.5 nm excited SERS spectra of 10^{-3} mol/L solutions of S-1 and S-2 on silver colloid are shown in Fig. 3. Two series of bands can be distinguished, one including the bands at 1 622 ,

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* Corresponding author

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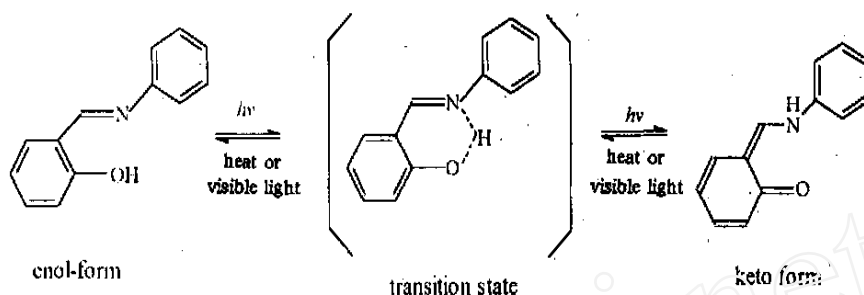


Fig. 1 Photochromism of salicylidineanilines

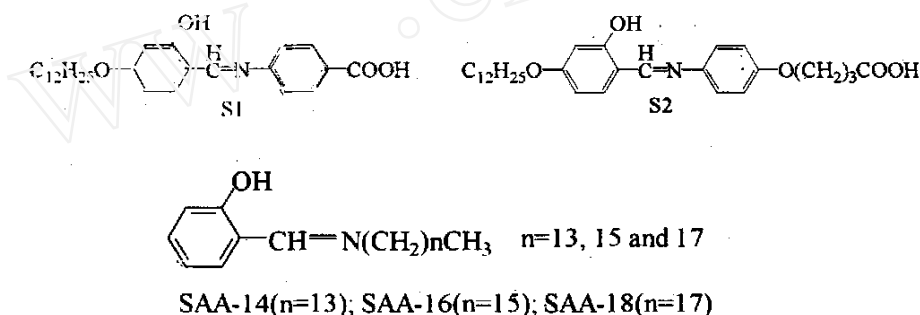


Fig. 2 Structure of S 1 , S 2 and SAA

1 602 , 1 547 , 1 515 , 1 445 , 1 363 and 1 198 cm^{-1} and the others at 1 347 , 1 238 and 1 176 cm^{-1} . The first set of bands is well correlated with those due to salicylidineanilines ring. The latter set arises from the $-\text{COO}^-$ group.

Fig. 4 shown the SERS results of dipping films of S-1 and S-2 on silver mirror surface. The bands can also be distinguished into two series. In all SERS spectra , the 1 602 and 1 352 cm^{-1} appear as stronger bands. They can be assigned to $\text{C}=\text{C}$ stretching and $-\text{COO}^-$ symmetric stretching modes , respectively. For the silver colloid system , we can conclude that the molecules of two samples give a similar orientation and conformation on the surface of silver colloid particles. However the spectrum of dipping film of S-1 shows clear difference compared with others ; the 1 602 and 1 352 cm^{-1} bands show great enhancement in comparison with the others. These results mean that the long axis of the S-1 molecule is almost perpendicular to the surface of the silver mirror.

Fig. 5 shows the SERS spectra of SAA1 , SAA2 and SAA3 (10^{-3} mol/L) on the silver colloid. The band at 1 632 cm^{-1} is assigned to $\text{C}=\text{N}$ stretching mode , and the bands around 1 600 and 1 400 cm^{-1} are due to the vibrational modes of the benzene rings. The spectra of three sam-

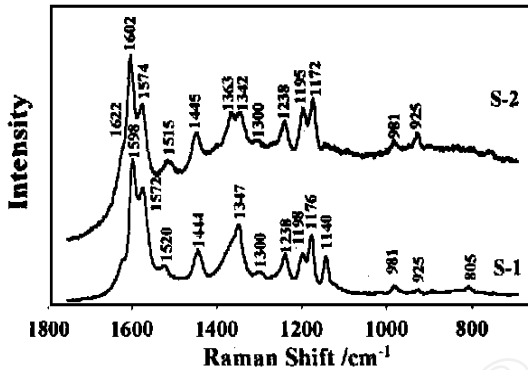


Fig. 3 The 514.5 nm excited SERS spectra of 10^{-5} mol/L solutions of S-1 and S-2 on silver colloid

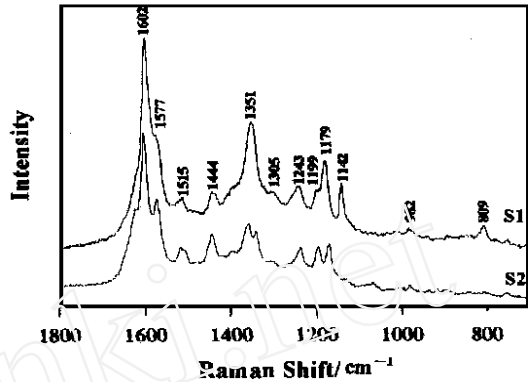


Fig. 4 The 514.5 nm excited SERS spectra of S-1 and S-2 on silver mirror surface

ples are similar to each other, suggesting that the SAA molecule can absorb on the surface of silver colloid particle. From the intense Raman band of C=N stretching mode in Fig. 2, it can be concluded that the absorbate is the C=N group. The intense C-N stretching band appears at 1135 cm^{-1} also supports the above conclusion.

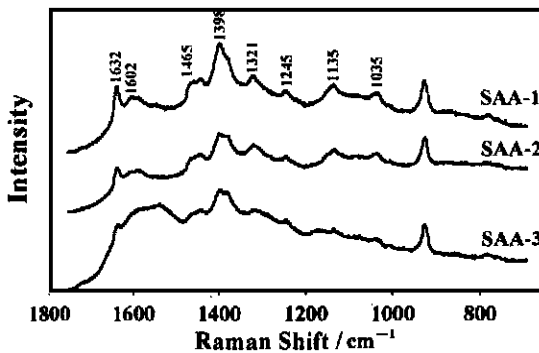


Fig. 5 The 514.5 nm excited SERS spectra of SAA1, SAA2 and SAA3 (10^{-3} mol/L) on silver colloid

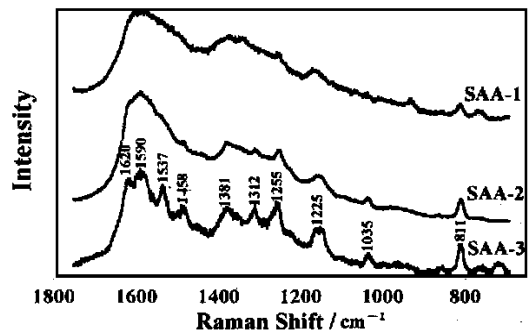


Fig. 6 The 514.5 nm excited SERS spectra of dipping films of SAA1, SAA2 and SAA3 on silver mirror surface

From Fig. 6, we can see that just SAA3 shows clearly Raman bands. The SERS spectra of other two samples give the broad bands. This suggests that only SAA1 absorbed on silver mirror surface has an approximately uniform orientation and conformation, or the other two samples are very easy to be destroyed by laser.

We also try the SERS of S-1 and S-2 on gold colloid, the spectra just shown the background

of gold colloid, there is no any peak relation with sample can be observed. Thus we can suppose that the gold colloid is not suitable to absorb the salicylideneaniles.

Key words: SERS, Photochromic, Silver substrate, Gold substrate

References:

- [1] Barbara P F, Rentzepis P M, Brus L E. Photochemical kinetics of salicylideneaniline[J]. J. Am. Chem. Soc., 1980, 102:2 786.
- [2] Nakatani K, Delaire J A. Reversible photoswithing of second order nonlinear optical properties in an organic photochromic crystal[J]. Chem. Mater., 1997, 9:2 682.
- [3] Mitra S, Tamai N. Femtosecond spectroscopic study on photochromic salicylideneaniline [J]. Chem. Phys. Lett., 1998, 282: 391.
- [4] Sekikawa T, Kobayasi T, Inabe T. Femtosecond fluorescence study of the substitution effect on the proton transfer in thermochromic salicylideneaniline crystals [J]. J. Phys. Chem., 1997, 101:644.
- [5] Turbeville W, Duttu P. Spectroscopic studies of the photochromic molecule N-(2-Hydroxybenzylidene) aniline and its photoproduct [J]. J. Phys. Chem., 1990, 94:4 060.
- [6] Collins S J, Dhathathreyan A, Ramasami T, et al. Langmuir and Langmuir-Blodgett films of octadecylaminodihydroxysalicylaldehyde [J]. Thin Solid Films, 2000, 358:229.

一类西弗碱基光致异构化分子在不同基底上的表面增强拉曼光谱

赵 冰¹, 尾崎幸样²

(1. 吉林大学超分子结构与谱学教育部重点实验室, 吉林 长春 130023;

2. 日本关西学院大学理学部, 日本 西宫市 662-8501)

摘要: 由水杨醛衍生得到的 Schiff 碱由于其具有起因于受激分子内质子转移的光致(热致)变色性质而受到了人们的重视. 本文利用表面增强拉曼光谱研究了该类化合物在金、银基底及银溶胶表面上的拉曼光谱, 比较了不同基底对吸附分子结构的影响.

关键词: 表面增强; 拉曼光谱; 金、银、基底