Localized Surface Plasmon Resonance Gas Sensor Based on Molecularly Imprinted Sol-gel for Selective cis-Jasmone Vapor Detection

Liang Shang[1], Chuanjun Liu[1,2], Kenshi Hayashi[1*]

[1]Department of Electronics, Graduate School of Information Science and Electrical Engineering, Kyushu University

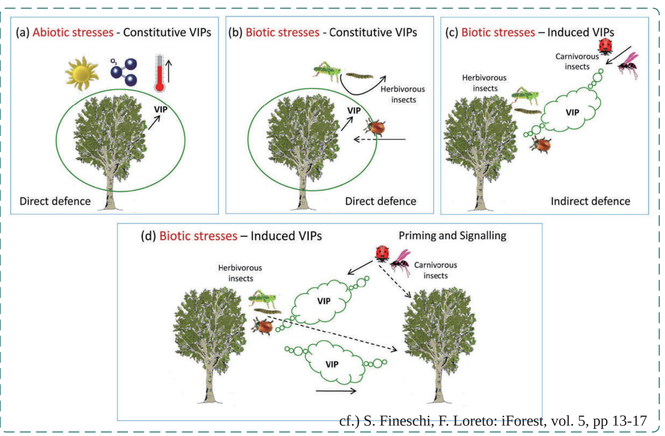
[2]Research Laboratory, U.S.E. Co., Ltd., Tokyo

Email: shang.liang.100@s.kyushu-u.ac.jp

九州大学 KYUSHU UNIVERSITY

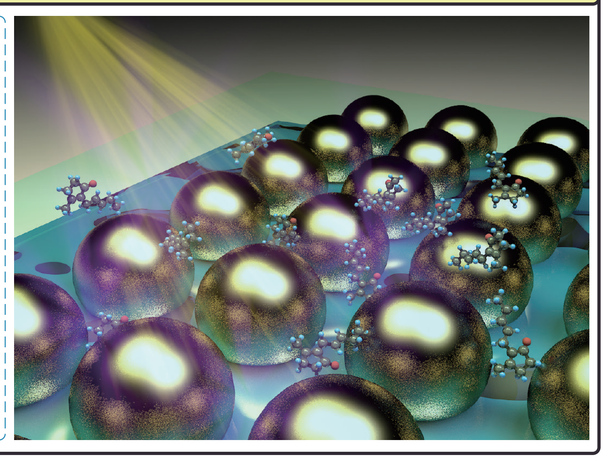
Information Science and Electrical Engineering Kyushu University

INTRODUCTION



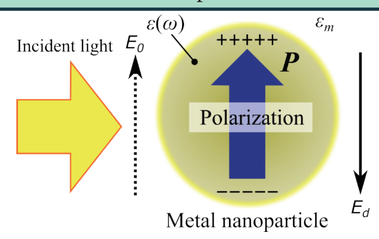
cf.) S. Fineschi, F. Loreto: iForest, vol. 5, pp 13-17

- Plants can release volatile organic compounds (VOCs) when they withstand the physical damage or stresses.
- *cis*-Jasmone is one of important VOCs which was induced on damage to plant issue.
- The detection of *cis*-Jasmone is meaningful to sense the potential threat in agriculture.
- Here, a localized surface plasmon resonance (LSPR) sensor based on molecular imprinted sol-gel (MISG) film was employed for cis-jasmone vapor detection. (Fig. 1)
- The responsibilities and selectivities for LSPR sensors coated MISGs with different functional monomers were evaluated and discussed.

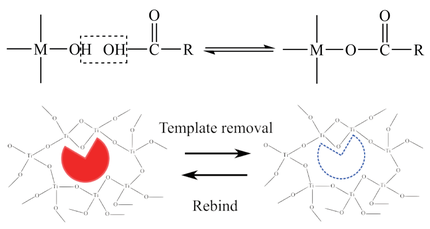


EXPERIMENTAL

Localized surface plasmon resonance



Molecularly imprinted sol-gel



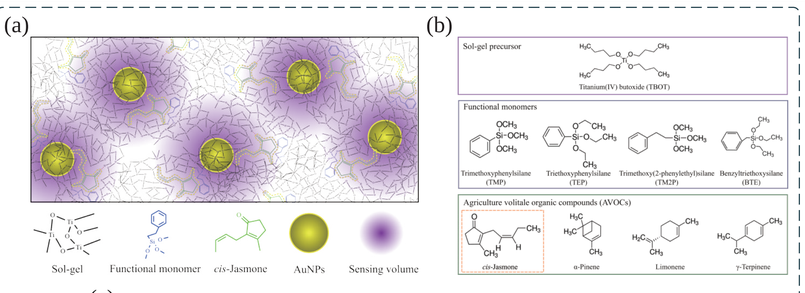


Fig. 1. Sensing mechanism (a), chemicals (b) and testing system (c) used in this study.

MISG-AuNPs film fabrication

Step 1
APTES modification

(3-Aminopropyl) triethoxysilane

APTES ethanol solution (v:v = 1:10), 8 h

Glass substrate

Step 2
Sputtered AuNPs and anneal

Sputtering AuNPs thinkness: 3nm
Anneal: 500 ºC, 2h, air
Repeat 2 times.

Glass substrate

Step 3
MISG reaction solution spin coating

MISG solution: 20 µL
Spin coating speed:
3000 rpm

Template molecules — Titanate sol-gel martix

Glass substrate

Step 4
Annealed for removing templates

Anneal: 130 ºC, 1h, air

Glass substrate

MISGs material

Iso-propanol	2 mL
TBOT	150 µL
FM	50 µL
cis-Jasmone	50 µL
$TiCl_4$	25 µL

60 ºC water bath, 1h

Reference

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RESULTS AND DISCUSSIONS

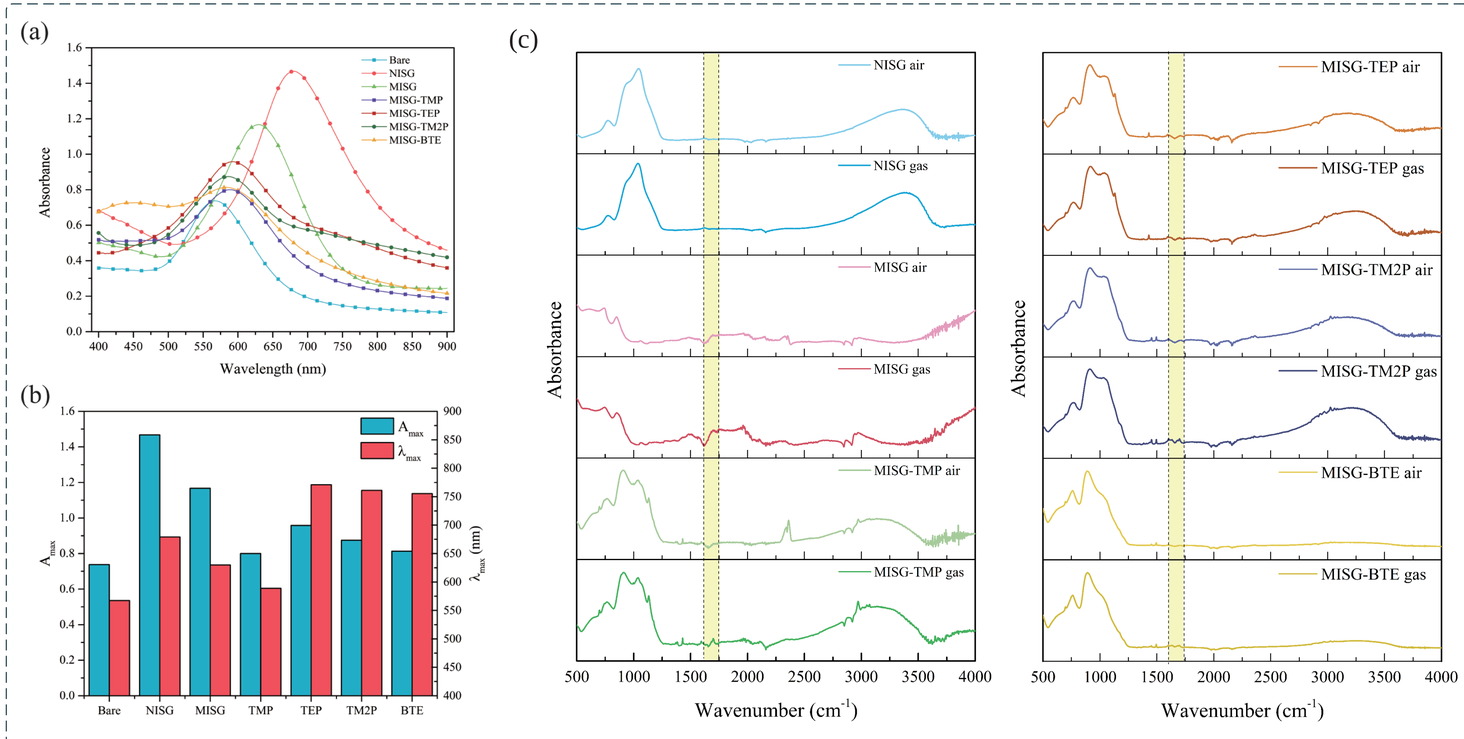

Fig. 2. Absorption spectra for samples coated with different functional monomers (a), optical features (b) and FT-IR spectra (c).

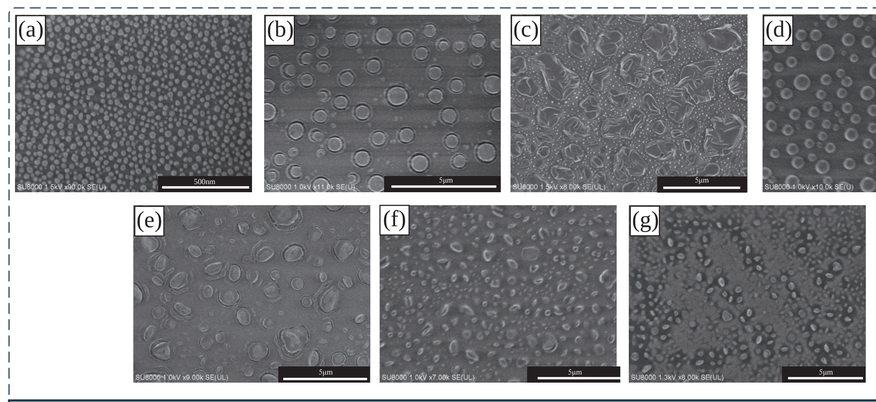

Fig. 3. SEM images of bare (a), NISG (b), MISG (c), TMP-MISG (d), TEP-MISG (e), TM2P-MISG (f) and BTE-MISG (g) coated samples.

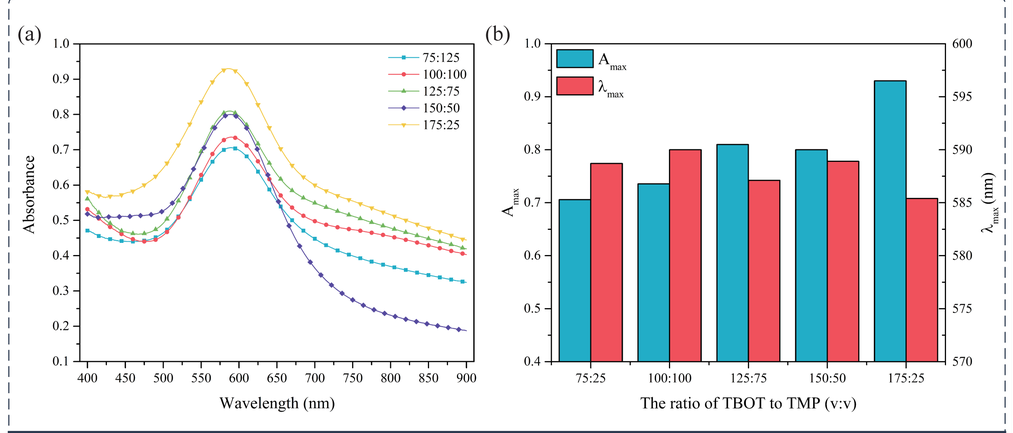

Fig. 4. Absorption sepctra (a) and optical features (b) for samples coated wtith different ratio of TBOT to TMP

Fig. 5. Real-time responses of MISG (a), TMP (b), TEP (c), TM2P (d), BTE (e) coated samples and their responses summary (f).

Fig. 6. Real-time responses of TMP-MISG coated samples with different ratio of TBOT to TMP (v:v) 75:125 (a), 100:100 (b), 125:75 (c), 150:50 (d), 175:25 (e) and their responses summary (f).

CONCLUSIONS

- A MISG coated Au nano-island film was developed for determination of cis-Jasmone vapors selectively.
- Functional monomers were added for enhancing the responses for MISG-LSPR sensors.
- The results demonstrated that the adsorption of pure TiO2 sol-gel matrix was weak.
- The effects for spin coating 4 types of functional monomers (TMP, TEP, TM2P and BTE) were detected and evaluated.
- Although pure MISG had a good selectivity for target vapor, its response was poor.
- The results indicated that sample coated with MISG-TMP would be the optimal sensor for cis-Jasmone detection.
- Besides, the ratios of TBOT to TMP were also discussed in this study.
- This research offered some useful technologies for developing sensors for AVOCs.