Localized surface plasmon resonance gas sensor based on molecularly imprinted sol-gel for selective *cis*-jasmone vapor detection

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Abstract: *cis*-jasmone is well known as an important component of plant volatiles, which release can be induced by physical damage, such as insect herbivory. Therefore, *cis*-jasmone detection is meaningful to sense the potential threat in agriculture. In this work, a localized surface plasmon resonance (LSPR) sensor based on molecular imprinted sol-gel (MISG) film was employed for *cis*-jasmone vapor detection. In order to obtain the highest selectively MISG film, 4 types of functional monomers were added to enhance the imprinting effects, respectively. MISG films were constructed on AuNPs by spin coating. Their responses on 4 types of agriculture volatile organic components (AVOCs) were studied and evaluated. The results show that samples coated the MISG which mixed with trimethoxyphenylsilane (TMP) as the functional monomer shown a better responses and selectivities than others. The developed MISG coated LSPR sensor would be applied for the detection and recognition of *cis*-jasmone from AVOCs.

1. Introduction

Plants can release abundant of volatile compounds when they withstand the damage and stresses caused by herbivorous insects or abiotic factors, which can affect the behavior of insect herbivores searching for a food source. *cis*-jasmone is a component of flower volatiles, which was also known to be induced on damage to plant issue. Therefore, *cis*-jasmone detection is meaningful to sense the potential threat in agriculture. In this work, a LSPR sensor based on MISG film was employed for selective *cis*-jasmone vapor detection (Fig. 1).

2. Experimental

In this research, sol-gel layer was prepared by dissolving 150 μL tetrabutoxy titanium as a precursor in 2 mL of iso-propanol and 50 μL *cis*-jasmone was added as template molecules. Besides, 50 μL TMP, triethoxyphenylsilane (TEP), trimethoxy(2-phenylethyl)silane (TM2P) or benzyltriethoxysilane (BTE) were added as functional monomers in MISG matrix. 25 μL titanium tetrachloride was added to initialize the reaction. Then, the solution was heated at 70 °C water bath for 1 h. A substrate was put into a quick coater for AuNPs deposition, and annealed in air atmosphere at 500 °C for 2h. MISGs were constructed on the AuNPs film by spin coating 20 μL of MISG solution at a spinning rate of 3000 rpm. Finally, samples were heated at 130 °C for 1 h to remove template molecules from the MISGs. Spectra testing system was shown in Fig. 2.

3. Results and discussion

The normalized responses of MISGs/NISG coated LSPR sensors to *cis*-jasmone, α-pinene, limonene and γ-terpene vapors were shown in Fig. 3. It demonstrated that samples coated with TMP-MISGs shown a better selectivity and response than TEP-MISG, TM2P-MISG and BTE-MISG coated samples'. It indicated that TEP is more suitable for constructing *cis*-jasmone MISG layer than other functional monomers. The result suggested that TEP-MISG layer would play a vital role in absorption of *cis*-jasmone vapors selectively.

4. Conclusion

In this study, MISG based LSPR sensor was developed for the detection of *cis*-jasmone vapor selectively. Compare with other functional monomers, TMP shown a competitive selective response for *cis*-jasmone. It also offers some useful technologies for developing sensors for AVOCs. In addition, a sensor array constructed with several of MISG coated LSPR sensors would be developed for varieties of AVOCs.

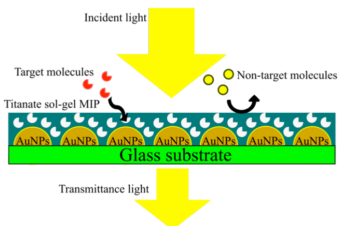
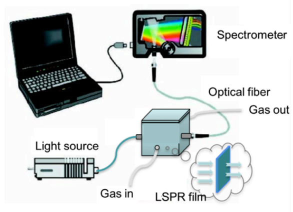


Fig. 1. Schematic diagram of MISG-coated AuNPs film.



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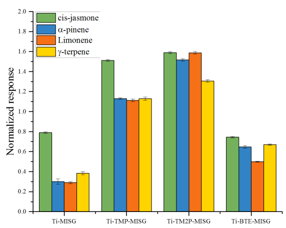

Fig. 3. Normalized responses of MISG-LSPR sensors to AVOCs.