

原位、快速、敏：使用网印刷的化学 SERS

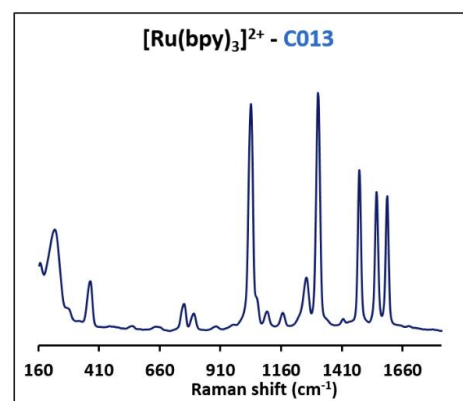
Substrates for surface-enhanced Raman spectroscopy (SERS) are typically fabricated with complex (micro/nano)structures of noble metals, enabling trace level detection of analytes. Due to the high costs and reactivity of these SERS substrates, they often have a limited shelf life. Development of new substrate materials which minimize these issues yet maintain the same performance standards is a constant concern. Screen-printed electrodes can be easily

fabricated using different metallic materials with the well-established screen-printing method, leading to mass production of versatile, cost-effective, and disposable devices. In this Application Note, the feasibility of using readily-available screen-printed metal electrodes as suitable substrates for the fast and sensitive detection of different chemical species by in situ electrochemical SERS (EC-SERS) is shown.

INTRODUCTION

Substrates for surface-enhanced Raman spectroscopy (SERS) are typically fabricated with complex (micro/nano)structures of noble metals to obtain high surface-area plasmonic surfaces, which are capable to enhance this effect and, therefore, the detection of chemical species at very low concentrations. These substrates are frequently high-priced and because their high reactivity, they often have a limited shelf life. Development of new SERS substrates that minimize these issues but preserving a good analytical performance is a constant concern. Screen-printed electrodes can be easily fabricated with different metallic materials and the well-established screen-printing method leading to mass production of versatile, cost-effective and disposable devices. They could be promising SERS substrates.

In this Application Note, the feasibility of using readily- available screen-printed metal electrodes as cost-effective and disposable substrates for the fast and sensitive detection of different chemical species by in situ electrochemical SERS (EC-SERS) is shown.



EQUIPMENT

The fabulous, compact and integrated instrument for Raman Spectroelectrochemistry, SPELEC-RAMAN, was used. This instrument integrates in only one box: a spectrometer, a laser source (785 nm) and a bipotentiostat/galvanostat.

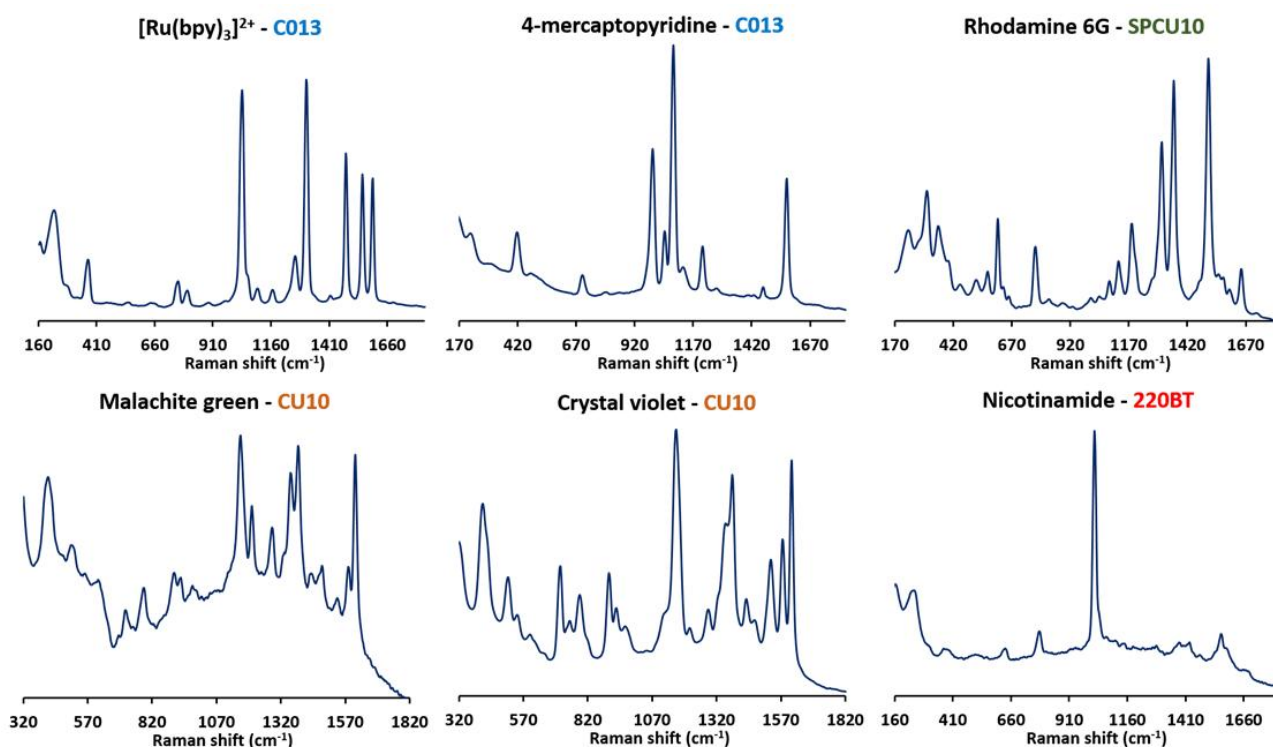
Screen-printed metal electrodes (refs. **C013** (Silver), **220BT** (Gold), **CU10** (Copper), **SPCU10** (Silver/Copper)) were placed in the Raman cell (**RAMANCELL**) coupled with the **RAMANPROBE**, which allows to perform Raman measurements of the electrode surface at the optimal focal distance.



METHODS

Screen-printed electrodes were electrochemically activated by cyclic voltammetry: **C013** (from +0.3 V to -0.4 V), **220BT** (from +0.6 to +1.2 V to -0.2 V), **CU10** (from +0.15 V to -0.6 V) and **SPCU10** (from +0.10 V to -0.4 V). A 60 μ L solution of 0.1 M KCl containing the specific analyte was used for the

in situ and simultaneous activation and detection. Concentrations were: 250 nM for $[\text{Ru}(\text{bpy})_3]^{2+}$, 2 μ M for 4-mercaptopyridine, 20 μ M for Rhodamine 6G, 15 nM for Malachite green, 2.5 μ M for Crystal violet and 80 μ M for Nicotinamide.



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785 nm

SPELECRAMAN 是一可行光化学拉曼量的器。SPELECRAMAN 将一个 3B 激光器 ($785 \text{ nm} \pm 0.5$)、一个双恒位/恒流和一个光(波范:787 - 1027 nm,拉曼位移: $35 - 3000 \text{ cm}^{-1}$)合在一个箱子中,并配有用的光化学件,可同步行光学和化学。



反射探用于激 785 nm 波(高 500 mW)。用于与网印刷 DropSens 拉曼流通池或任何拉曼装置一起工作。



黑色聚四乙反射池,用于网印刷合参考 RAMANPROBE 行拉曼光化学量。