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A Novel Substrate Used for Simultaneous SERS and RAIR

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Abstract: A novel substrate, whose silver particles were deposited on both sides of a slide, was made by silver mirror reaction. Its two sides had different thinness and reflectivity and they were suited for the test of surface enhanced Raman spectroscopy (SERS) and reflection absorption infrared spectroscopy (RAIR) technique respectively.

Keywords: SERS, RAIR, polymer-metal interface.

Reflection-absorption infrared spectroscopy (RAIR) and surface-enhanced Raman spectroscopy (SERS) are very useful in determining the molecular structure and orientation in the thin films of polymers[1-2].

However, it is a pity that the two techniques have different sampling demands. The molecules adsorbed onto the roughened surfaces of certain metals have the surface-enhanced Raman spectra but the RAIR test needs the thin film adsorbed on reflecting and smoothing metal substrate. So it is difficult to test the same thin film-metal sample by the RAIR and SERS technique simultaneously

In this work, by silver mirror reaction, a novel substrate is prepared and its two sides had different thinness and reflectivity and they are suited for the test of SERS and RAIR technique respectively. In a 10 mL beaker, there was a 20 × 10 × 1 mm glass plate tilting upon it, which was washed with water and acetone. 5 mL 1×10^{-2} mol/L silver ammonia complex and 1 mL glucose water solution (10%) was mixed in the beaker. 30 minutes later, withdrawing the glass plate and washing it with distilled water and dried with nitrogen. Because of gravity, some larger aggregated silver particles sediment on the top and only relatively small silver particles adsorb on the bottom of the glass plate. As a result, one side of the substrate is very rough and the other side is very smooth. **Figure 1** shows the model of the substrate and the sampling process. The sampling method was "dip-coating": the substrate was immersed into a polymer solution at 30°C for 1 min and after withdrawal of the sample, the solvent was evaporated.

There are already many reports about the SERS spectrum of polystyrene (PS)[3]. In order to compare, the PS /$CHCl_3$ solution with concentrations of 1% was chosen as sample. All spectra were recorded on Bruker IFS 55/FRA 106 spectrometer. The RAIR spectra and SERS spectrum were obtained by averaging 256 and 128 scans respectively.

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Figures 2 and **3** show the SERS and RAIR spectra of PS thin film on the substrate respectively, both spectra have a very good quality. Especially the SERS spectra of the PS, there are more information than the bands at 1600 cm^{-1} and 1000 cm^{-1} which have been reported. The detail discussion of the two graphs will be given elsewhere.

Figure 1 Schematic view of the substrate and the sampling process

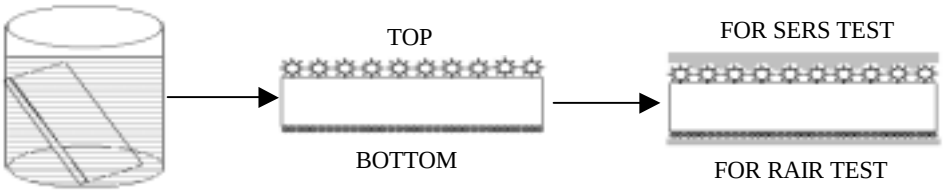


Figure 2 The SERS spectrum obtained from PS/Ag thin film

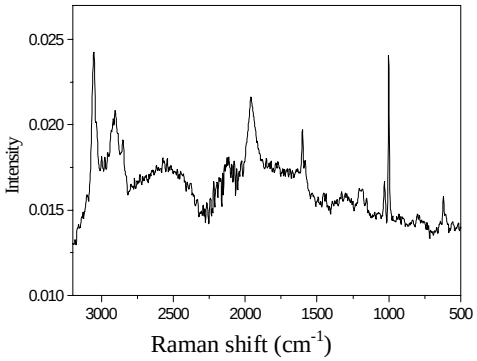
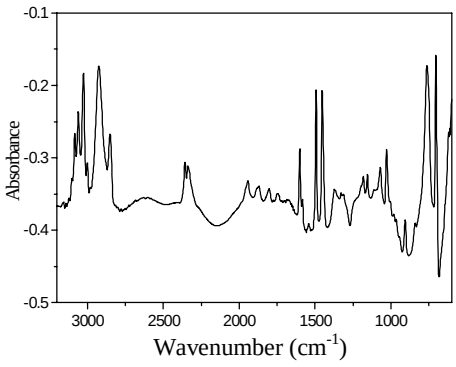


Figure 3 The RAIR spectrum obtained from PS /Ag thin film



Overall the novel substrate is suited for the SERS and RAIR techniques and upon it the high quality SERS and RAIR spectra of PS thin film can be acquired.

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