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Method Article

Direct deposition of silver nanoplates on quartz surface by sequence pre-treatment hydroxylation and silanisation

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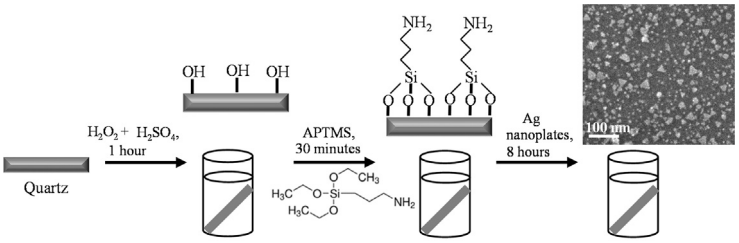
GRAPHICAL ABSTRACT



Pre-treatment process on a quartz surface for the silver nanoplates film deposition.

ABSTRACT

Silver nanoparticles deposited on quartz substrates are widely used as SERS substrates. The nanoparticles can be deposited directly from colloidal solution by dipping technique. However, the adhesion of the particles on the quartz surface is very poor. Normally the substrate is pre-treated with hydroxylation or silanisation process. In this paper, we have demonstrated that the application of the sequence pre-treatment hydroxylation and silanisation have improved the density of silver nanoplates desposited on the quartz surface.

- Sequence hydroxylation and silanisation pre-treatment assists the deposition of the nanoplate on the surface.
- Various immersion times of the quartz surface into the colloidal nanoplates determined size distributions and density surface of the nanoplates on the surface.

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Method details

The present study was designed to deposit triangular silver nanoplates thin film on a quartz surface from the colloidal nanoplates using a self-assembly technique. Triangular-shaped silver nanoplates were synthesised as reported previously using direct chemical reduction approach [1]. The materials used were quartz substrate (Latech Scientific Supply, Kuala Lumpur, Malaysia), 3-aminopropyl-trimethoxysilane 97% (Sigma-Aldrich, Kuala Lumpur, Malaysia), sulphuric acid 95% (Sigma-Aldrich), 30% hydrogen peroxide (HmbG Chemicals, Kuala Lumpur, Malaysia) and ethanol absolute (HmbG Chemicals). The normal-grade quartz substrate without a special specification was used with a measurement of 1.2×1.2 cm. These chemicals were used as received without any further purification.

Silver nanoplates thin film was prepared using a self-assembly technique by immersing a cleaned quartz surface into the colloidal nanoplates. In order to obtain a high density of the nanoplates on the surface, effects of pre-treatment on the quartz surface were studied prior to being immersed into the colloidal. After that, the various immersion times of the quartz surface into the colloidal nanoplates was carried out to observe the coverage of nanoplates distribution on the surface.

Pre-treatments on a cleaned quartz substrate surface

Two pre-treatment studies, namely hydroxylation and silanisation were done on a cleaned quartz surface to study adhesion of the nanoplates on the surface. Quartz substrate was consecutively cleaned in acetone and then 2-propanol using a sonication process for 15 min. After that, the surface was dried and prepared for pre-treatment prior to depositing the nanoplates on the surface by immersing the surface into the colloidal nanoplates. Flow chart for pre-treatment preparation on the surface is described in Fig. 1.

In a typical pre-treatment process, the cleaned quartz substrates were first treated with and without hydroxylation treatment. Hydroxylation treatment was prepared by immersing the cleaned quartz surface for 1 h in 1:3 (v/v) hydrogen peroxide:sulphuric acid. After that, the surface was taken out and consecutively cleaned in deionised water and then ethanol using a sonication process for 15 min. Finally, the surface was rinsed with a copious amount of deionised water and then was dried in air.

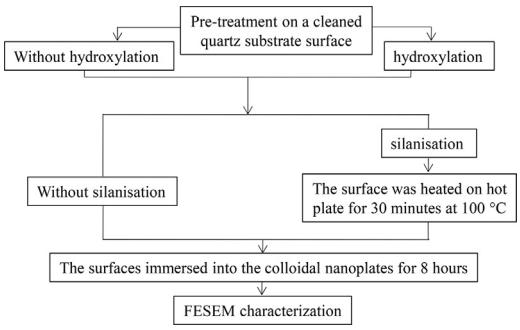

Fig. 1. A flow chart of the pre-treatments on the quartz surface to prepare the nanoplate thin film.

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