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Silver nanoparticles: citrus peel extracts mediated synthesis, self-assembly nanostructure and its application as SERS substrate

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Introduction

Silver nanoparticles (AgNP) have had a substantial impact across a diverse range of fields such as catalysis, sensing, and medicine.[1] Silver has desirable physical properties, good relative abundance and low-cost, which make it an attractive material for several applications.[1] Recently, a large amount of works have been developed to study the optical properties of AgNP, which could support localized surface plasmon resonance (LSPR). LSPR excitations are the most important factor for generating strong optical fields in these nanostructures. Consequently, the materials that support LSPR can be used in surface-enhanced Raman scattering (SERS). Recently, several studies has been focused on green nanoparticles synthesis approaches, including AgNP, to avoid hazardous materials.[2] Also, these eco-friendly synthetic approaches are based on use of plant extracts, which make these processes simple, and low-cost effective. Although a lot of research dealing with metallic AgNP synthesis using plant extracts have been published, the use of these nanoparticles in plasmonics and/or SERS studies has not been investigated so far. The objective of this work was to synthesize AgNP using citrus peel extracts, to explore its plasmonics properties, and to investigate their SERS activity.

Results and Discussion

AgNP were synthesized using citrus peel extracts such as *Citrus sinensis* (orange fruit, AgNP-Ora, average size 31 nm), *Citrus reticulata* (tangerine fruit, AgNP-Tan, 30 nm), and *Citrus aurantiflora* (lemon fruit, AgNP-Lem, 19 nm), Figure 1. FTIR spectra of the citrus peel extracts indicate the presence of several functional groups, which can be associated with the presence of bioactive compounds such as flavonoids, citric acid, carotenoids, and aromatic compounds. The synthesized AgNP are spherical-like shape and are highly crystalline, and they were self-assembled on NH_2-modified glass slides, obtained AgNP aggregates substrate for all three prepared silver colloids. SERS activity of the AgNP substrates were explored, being possible to detected with high signal-to-noise the SERS spectral pattern of all Raman probe molecules on AgNP substrates, as shown in Fig. 2.

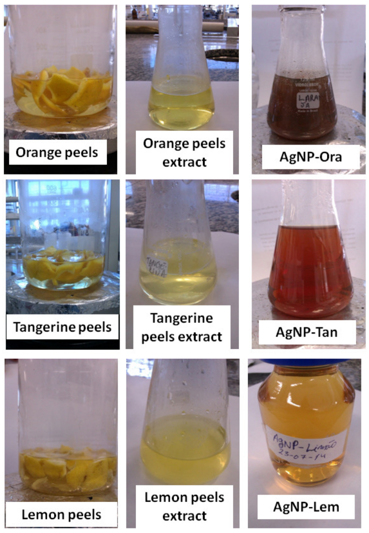

Figure 1. Picture of the AgNP syntheses.

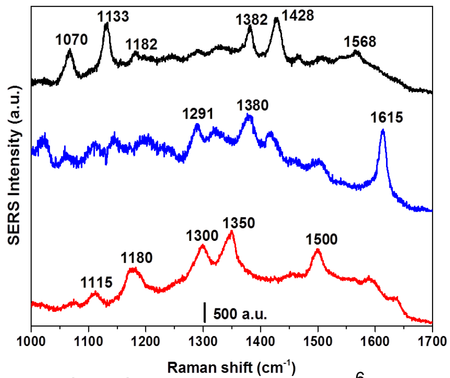

Figure 2. SERS spectra of 10^{-6} mol L^{-1} 4-aminobenzothiol (black), methylene blue (blue), and Rhodamine 6G (red) on AgNP-Ora substrates

Conclusions

The as-synthesized AgNP are stable and exhibit LSPR band at visible range. It was possible to detected with high signal-to-noise the SERS spectral pattern of all Raman probe molecules for all the three AgNP substrates.[3]

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