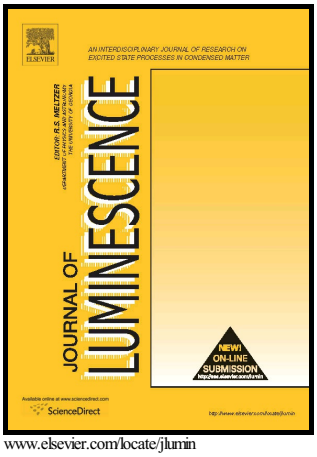

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Selective Rayleigh Light Scattering Determination of Trace Quercetin with Silver Nanoparticles

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Abstract

Rayleigh light scattering (RLS) is a simple technique with a high potential of sensitive determination of small organic molecules. We have found that ppb amounts of quercetin (Qu) greatly enhance the RLS of the solution of silver nanoparticles (AgNPs) stabilized with cetyltrimethylammonium bromide (CTAB) or sodium *n*-dodecyl sulfate (SDS). Enhancement of light scattering is observed only in the presence of an excess of $AgNO_3$, which implies that it is a result of nanoparticle growth; another reason for the enhanced scattering is the aggregation of AgNPs by the analyte that was confirmed by dynamic light scattering technique. The conditions were chosen for the determination of Qu in aqueous solution with the detection limits of 0.01 and 0.03 μmol·L^{-1} and linear ranges of 0.1–1.3 and 0.1–2.0 μmol·L^{-1} for SDS- and CTAB-stabilized AgNPs, respectively; the intra-day RSDs did not exceed 7%. Unexpectedly, other bioflavonoids (rutin, dihydroquercetin, and naringenin) did not change the signal of Qu and did not interfere with its determination in 1:1 molar ratio (0.5 μmol·L^{-1} each). Other compounds (asparagin, uric acid, urea, some inorganic ions) were also tolerated in high amounts.

Keywords: silver nanoparticles, Rayleigh light scattering, quercetin determination, bioflavonoid, sodium *n*-dodecyl sulfate, cetyltrimethylammonium bromide

Abbreviations

AgNPs – silver nanoparticles; AuNPs – gold nanoparticles; CTAB – cetyltrimethylammonium bromide; DLS – dynamic light scattering; HEPES – 4-(2-hydroxyethyl)-piperazine-1-ethanesulfonic acid; MOPS – 3-(N-morpholino)propanesulfonic acid; Qu – quercetin; RLS – Rayleigh light scattering

1. Introduction

Rayleigh light scattering (RLS) technique was suggested in 1990s for the study of self-association of absorbing molecules [1]. RLS spectra are recorded using a conventional spectrofluorimeter in a synchronous mode, at equal excitation and emission wavelengths. Simplicity and high sensitivity (limits of detection (LODs) may be at ppb level) are the main advantages of RLS as analytical method [2]. Still the technique is undeservingly rarely used in practice, including its possibilities for the determination of small organic molecules. Use of noble metal nanoparticles (NPs) opens the feasibility for highly sensitive RLS assays of various organic analytes. As the RLS signal may be enhanced by the surface plasmon resonance effect of noble metal NPs, the sensitivity of RLS methods can be increased by using this type of nanoparticles [3, 4]. The mechanisms of increasing the Rayleigh scattering by the analytes involve aggregation of existing NPs, formation of the new NPs as a result of reduction of free metal ions and growth of the existing NPs. Formation of silver nanoparticles