

SINTESIS NANOPARTIKEL PERAK TERFUNGSIONALISASI ASAM TIOGLIKOLAT SEBAGAI AGEN SENSOR UNTUK APLIKASI DETEKSI ION Hg^{2+} SECARA KOLORIMETRI

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INTISARI

Pada penelitian ini telah dilakukan pengembangan sensor untuk deteksi ion Hg^{2+} melalui modifikasi nanopartikel perak dengan asam tioglikolat (AgNPs–TGA). Sintesis AgNPs–TGA dilakukan pada variasi konsentrasi $AgNO_3$ dan $NaBH_4$ serta volume TGA. Hasil sintesis pada kondisi optimum digunakan untuk mempelajari stabilitas intensitas resonansi permukaan plasmon (SPR) pada berbagai kondisi lingkungan, yaitu variasi pH dan waktu penyimpanan pada suhu ruang maupun suhu 4 ± 2 °C. Karakterisasi AgNPs–TGA dilakukan menggunakan spektrofotometer UV-Vis, FTIR-ATR, TEM, dan analisis potensial zeta. Evaluasi kinerja AgNPs–TGA dalam mendeteksi ion Hg^{2+} dikaji melalui parameter linearitas, LOD, LOQ, dan presisi, serta diaplikasikan pada sampel air lingkungan menggunakan metode akurasi.

Hasil penelitian menunjukkan bahwa kondisi optimum sintesis AgNPs–TGA diperoleh menggunakan $AgNO_3$ 1 mM, $NaBH_4$ 2 mM, dan TGA 20 μ L. Penambahan TGA menyebabkan pergeseran resonansi permukaan plasmon (SPR) ke arah pergeseran merah. Morfologi permukaan AgNPs–TGA berbentuk bulat dan terdistribusi secara homogen dengan ukuran partikel rata-rata sebesar 8,38 nm. AgNPs–TGA memiliki nilai potensial zeta $-28,3 \pm 0,1$ mV dengan stabilitas yang baik pada rentang pH 4–10 serta penyimpanan pada suhu 4 ± 2 °C sampai dengan 49 hari. Metode deteksi ion Hg^{2+} menggunakan AgNPs–TGA memberikan koefisien regresi linear sebesar 0,9961, dengan nilai LOD 1,36 μ M, LOQ 4,13 μ M, dan standar deviasi relatif sebesar 0,87%. AgNPs–TGA juga berhasil diaplikasikan pada sampel air Sungai Kokap, Kabupaten Kulon Progo, DI Yogyakarta dengan persen perolehan kembali sebesar 95,73–107,76% pada sampel hulu dan 94,90–108,10% pada sampel hilir.

Kata kunci: AgNPs, asam tioglikolat, ion Hg^{2+} , kolorimetri, sensor

***SYNTHESIS OF THIOLYCOLIC ACID-FUNCTIONALIZED SILVER
NANOPARTICLES AS A SENSING AGENT FOR COLORIMETRIC
DETECTION OF Hg^{2+} IONS***

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ABSTRACT

This study developed a sensor for detecting Hg^{2+} ions by modifying silver nanoparticles with thioglycolic acid (AgNPs–TGA). AgNPs–TGA were synthesized by varying the concentrations of $AgNO_3$ and $NaBH_4$ as well as the volume of TGA. The synthesis products obtained under optimum conditions were utilized to study the stability of the surface plasmon resonance (SPR) intensity under various environmental conditions, including pH variations and storage durations at room temperature and 4 ± 2 °C. AgNPs–TGA were characterized using a UV-Vis spectrophotometer, FTIR-ATR, TEM, and zeta potential analysis. The performance of AgNPs–TGA in detecting Hg^{2+} ions was evaluated through linearity, LOD, LOQ, and precision parameters, and was applied to environmental water samples using an accuracy method.

The results showed that the optimum conditions for AgNPs–TGA synthesis were obtained using 1 mM $AgNO_3$ 2 mM $NaBH_4$, and 20 μ L TGA. The addition of TGA caused a shift in the surface plasmon resonance (SPR) towards the red shift. The surface morphology of AgNPs–TGA was spherical and homogeneously distributed with an average particle size of 8.38 nm. AgNPs–TGA had a zeta potential value of $-28,3 \pm 0,1$ mV with good stability in the pH range of 4–10 and storage at 4 ± 2 °C for up to 49 days. The Hg^{2+} ions detection method using AgNPs–TGA provided a linear regression coefficient of 0,9961, with a LOD value of 1,36 μ M, a LOQ of 4,13 μ M, and a relative standard deviation (RSD) of 0,87%. AgNPs–TGA was also successfully applied to water samples from the Kokap River, Kulon Progo Regency, DI Yogyakarta, with a recovery rate of 95,73–107,76% in upstream samples and 94,90–108,10% in downstream samples.

Keywords : AgNPs, thioglycolic acid, Hg^{2+} ions, colorimetry, sensor