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Synthesis of Cu Nanoparticles

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Abstract

The present study concentrates on the synthesis of Cu nanoparticles (CuNPs) using aqueous solution of Polyvinylpyrrolidone (PVP) and tetrachloroaurate by different methods as thermal, sonochemical and electrochemical reduction. As the size of produced nano particles depends on the reaction conditions, we studied the effect of some factors such as the concentration of HCuCl4, the molecular weight of In electrochemical synthesis, the Taguchi method has been used to optimize the three parameters, interval time of synthesis, applied current density and concentration of HCuCl4. Characterization of CuNPs was carried out by Transition electron microscopy (TEM), UV-Vis spectroscopy, and particle size analyser. A large number of nanoparticles with different properties can be fabricated through the various preparation routes such as thermal , chemical, sonochemical, electrochemical , and sonoelectrochemical techniques. A solution of (0, 0.2, 0.4, 0.6 and 0.8) g PVP in 10 ml of deionized water was prepared. After complete dissolution of PVP, (0, 170, 340, 510 and 680 ppm) HCuCl4 was The current density, time of synthesis, and concentration of HCuCl4 as Taguchi factors were studied for investigation of the nanoparticle prepration.The Wing-1 (Standard Data Processing) program was used to determine the particle size of CuNPs.

Keywords- Synthesys, Deionized, CuNPs etc.

Results and Discussion

Thermal Reduction Method

The UV-Vis spectra of colloidal solution containing CuNPs prepared by the thermal method at different temperatures are shown in It is revealed that the absorption peak is increased with increasing the temperature. Run order

Coded values X1 X2 X3

λmax

1 0 0 0 577
2 0 0 0 571
3 0 -α 0 564
4 +1 -1 +1 579
5 +1 -1 -1 584
6 +1 +1 -1 575
7 +1 +1 +1 566
8 -1 -1 -1 537
9 0 +α 0 541
10 -1 -1 +1 545
11 0 0 +α 568
12 -α 0 0 553
13 0 0 0 564
14 0 0 0 573
15 -1 +1 +1 534
16 0 0 0 589
17 0 0 0 557
18 0 0 -α 569
19 +α 0 0 561
20 -1 +1 -1 529

It is well known that the PVP also acts as a stabilizer for the produced CuNPs and suppresses the further growth of the Au nanoparticles. Furthermore, the response surface methodology (RSM) was used to optimize the synthesis parameters Cinfluencing the particle size. The studied parameters were the amount of PVP, the sonication time and the initial HAuCl4 concentration. The three-dimensional response surfaces and two dimensional contour plots over independent variables are shown in Figs. 4-6. It is obvious that the Plasmon absorption band decreases by increasing the amount of PVP and decreasing the concentration of HAuCl4. This behavior can be seen in three-dimensional surface plot. It can be said that in the presence of higher

amount of PVP, the produced radicals increased presents the response surface and contour plots for Plasmon absorption band as functions of the irradiation time and concentration of the HCuCl4. As can be deduced from Fig. 5, a little/a shoet time is needed for synthesis of nanoparticles in lower concentrations of Cu. the minimum absorption band can be appeared in higher amount of PVP and

Conclusion-

The AuNPs were successfully synthesized by thermal, sonochemical and electrochemical methods. The optimum conditions, proposed by the RSM, for minimizing the particle size were found at high amount of PVP and low concentration of HAuCl4. The average size of the synthesized nanoparticles using this method is estimated to be 39 nm.

The galvanostatic method was successfully employed for electrochemical preparation of AuNPs in the presence of PVP. It is found that the applied current density has an important role on the size of synthesized particles. Taguchi orthogonal array was employed to optimize the current density and other parameters to reach the minimum average size of nanoparticles. The average size of the synthesized AuNPs by electrochemical method was estimated to be about 90 nm.

Consequently the results showed that the particle size of AuNPs obtained by the sonochemical method is smaller than that in both thermal and electrochemical methods. Furthermore, in thermal method a longer time is required to accomplish the reaction.

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