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Effect of Reaction Time on the Blue Shift of Chemically Created Silver Nanoparticles

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ABSTRACT

The structural properties of (Ag-NPs) nanoparticles prepared by the chemical method were examined using (XRD) diffraction. Additionally, the optical properties were tested using a UV-Vis spectroscopy instrument, and a scanning electron microscope was used to analyze the surface morphology, We found that (Ag-NPs) nanoparticles have the highest absorbance at wavelengths of (400)nm and that the granular size of these material ranges between (29 – 89)nm. And The morphology analysis further revealed that (Ag-NPs) particles are spherical in shape.

Keywords- Ag, nanoparticles, chemical, XRD, SEM.

I. INTRODUCTION

Nano-sized of (Ag-NPs) particles has gotten a lot of interest because of their outstanding characteristics, which can be used in a variety of sectors such as optics [1]. catalysts [2]. and biological materials [3]. Due to their potential as catalysts, noble metal nanoparticles like gold, silver, and palladium have drawn a lot of attention in recent years [4-7]. Depending on their size and morphologies, metal nanoparticles have better qualities including Plasmon resonance characteristics [8]. Since the beginning of time, silver has been utilized in the form of metallic silver, and silver nanoparticles are among the most frequent metal nanoparticles. Nanoparticles continue to be of interest in nanotechnology because of their excellent optical and electrical properties, as well as their high toxicity to a wide range of microbes [9]. The outer free electrons of silver nanoparticles (Ag-NPs) form localized Plasmons when light photons interact with their surface [10]. Several metallic nanoparticles, particularly silver nanoparticles, have this fascinating feature[11]. such as Plasmon resonance characteristics[12]. Some metallic nanoparticles have powerful plasmonic characteristics, which is an intriguing feature. [13]. are produced as a result of luminous photons interacting with the outside of meta-density waves and called plasmon-sand certain light wavelengths cause the outer electrons to jiggle, Surface plasmon resonances (SPR) are phenomena in which the levels of scattering and absorption of particles with plasmonic properties are substantially superior to those of the identical particles devoid of plasmonic characteristics, The importance of surface plasmon resonance reliant on particle characteristics[14]. Nanomaterials have physical, chemical, thermal, and biological characteristics [15]. Numerous characteristics of metallic nanoparticles include stability and thermal conductivity [16-17]. Additionally, it can be employed to create several nanostructure materials, that is spherical nanoparticles, nanoflowers, nanodiscs, and nanotubes in diverse shapes. [18-19].

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II. MATERIALS

Gallic acid, sodium hydroxide, and silver nitrate were acquired from BDH-Chemical Ltd, from England.

III. NANOPARTICLE SILVER SYNTHESIS TIPS

1. Dissolving (0,0095 g) of white nitrate silver salt with a molecular weight of purchased from in (100ml) of deionized water with continuous stirring for (10 minutes).
2. Dissolving Gallic acid white powder with a yellowish molecular weight of purchased from by (0,02 g) in (10 ml) deionized water and stirred continuously for (10 minutes).
3. Dissolving white sodium hydroxide salt in the form of small balls and of in deionized water with a concentration of (1M) with constant stirring for (10 minutes).
4. Add a Gallic acid solution of (10ml) to a solution of silver nitrate dissolved in water of (100ml) with continuous stirring and change the (PH) level of the solution by adding drops of sodium hydroxide solution until it reaches (PH=10).
5. Leave raise the solution temperature to (70 ç) for (45 min), and over the glass container with aluminum foil to keep it from exposure to light.

3.1 Characterization

X-ray diffraction and Field Emission Scanning Electron Microscopy (FESEM) were employed to examine the structure of (Ag-NPs) made by a chemical approach. UV-Vis spectroscopy examination was performed using the Shimadzu UV-1601 spectrophotometer.

IV. RESULTS AND DISCUSSION

4.1 Optical Properties

Chemical components are used to create the absorption spectra of Ag nanoparticles generated by the chemical approach. The absorbance of all samples was checked using a Shimadzu UV-Vis 1601 spectrophotometer, and we discovered that the highest values of absorbance are at the wavelength (400 nm), which depends on the concentration of (PH) value in sample preparation, and reaction temperature, and reaction time, where different concentrations of (PH) value were taken. And we discovered a value (PH=10) achieves the blue shift and Figure (1) displays the blue shift values for samples (S1,S2,S3,S4) with varied (PH) values; note that the PH of S1=9, and the PH of the S2=10 and the PH of the S3=11, and the PH of the S4=12

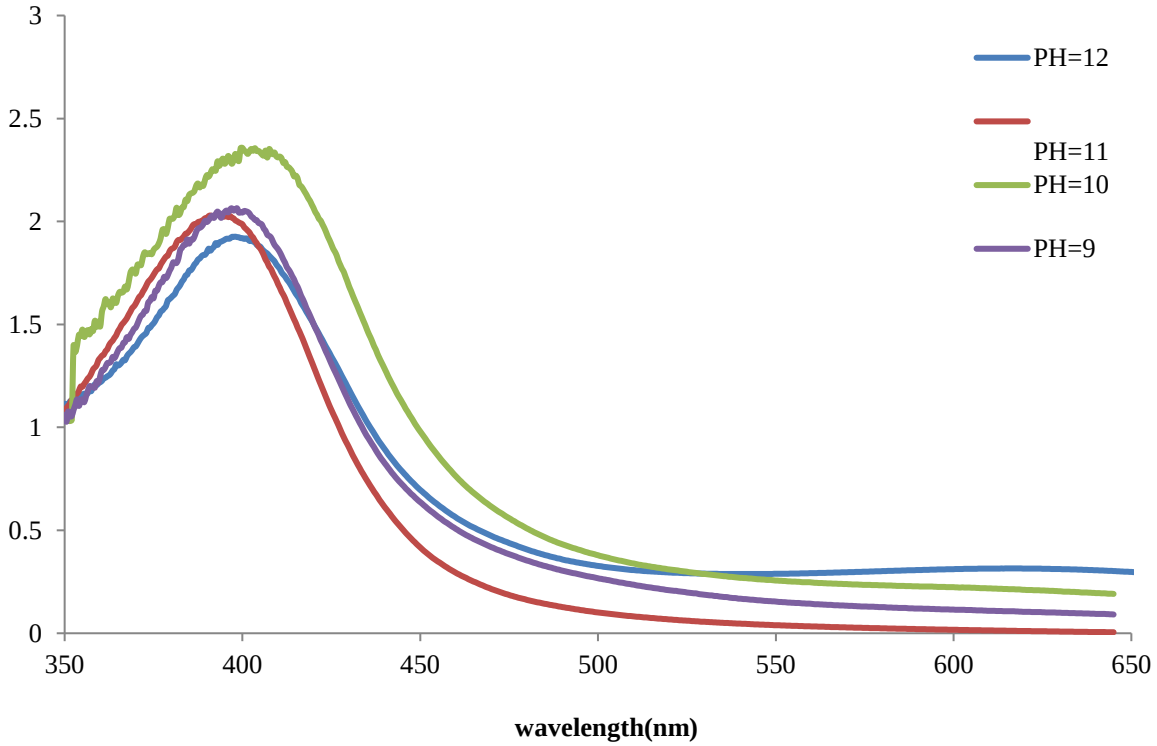

Figure 1: Plasmon resonances on surfaces absorbency at their maximum level of silver nanoparticles (Ag-NPs) in the region of blue shift at different concentrations (PH).

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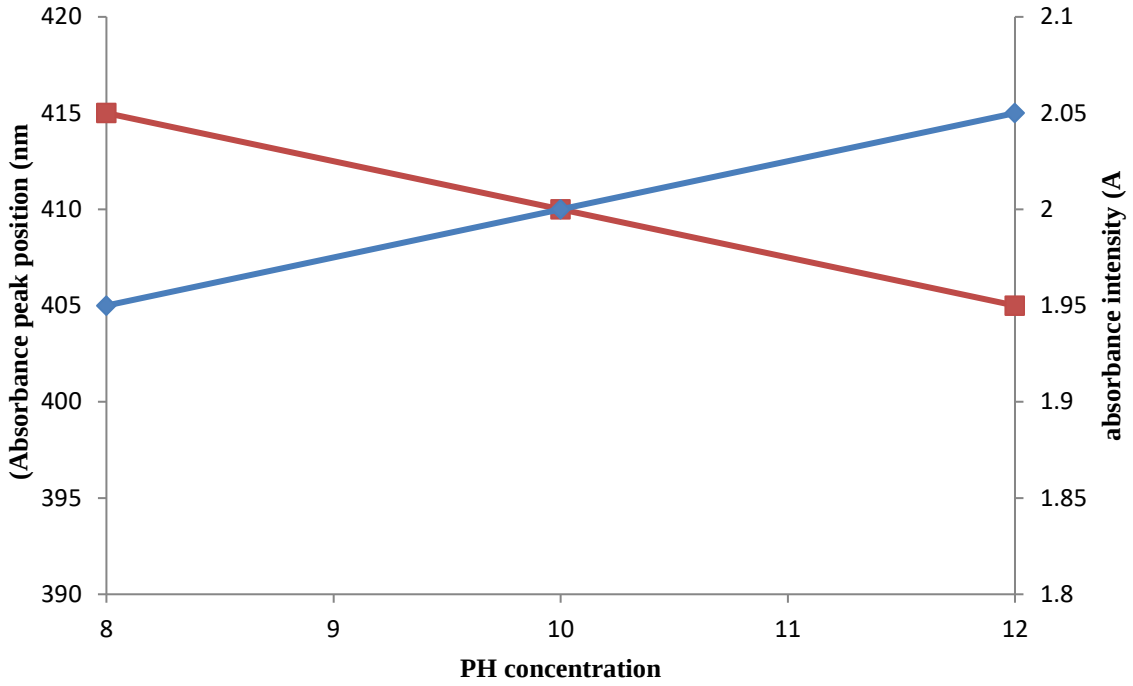

Figure 2: Silver nanoparticles' surface plasmon resonance (SPR) absorbance peak position and intensity concerning concentration (PH) values.

Different temperatures (70,80,90,100 C) were used to prepare the samples (S1,S2,S3,S4) in the second step of the preparation, and we discovered that 70 is the ideal temperature for achieving the maximum absorption peak for the blue shift of pure Ag nanoparticles. Note that S1 =70 degrees of Celsius, S2 =80 C of , S3 = 90 C and S4 =100 C

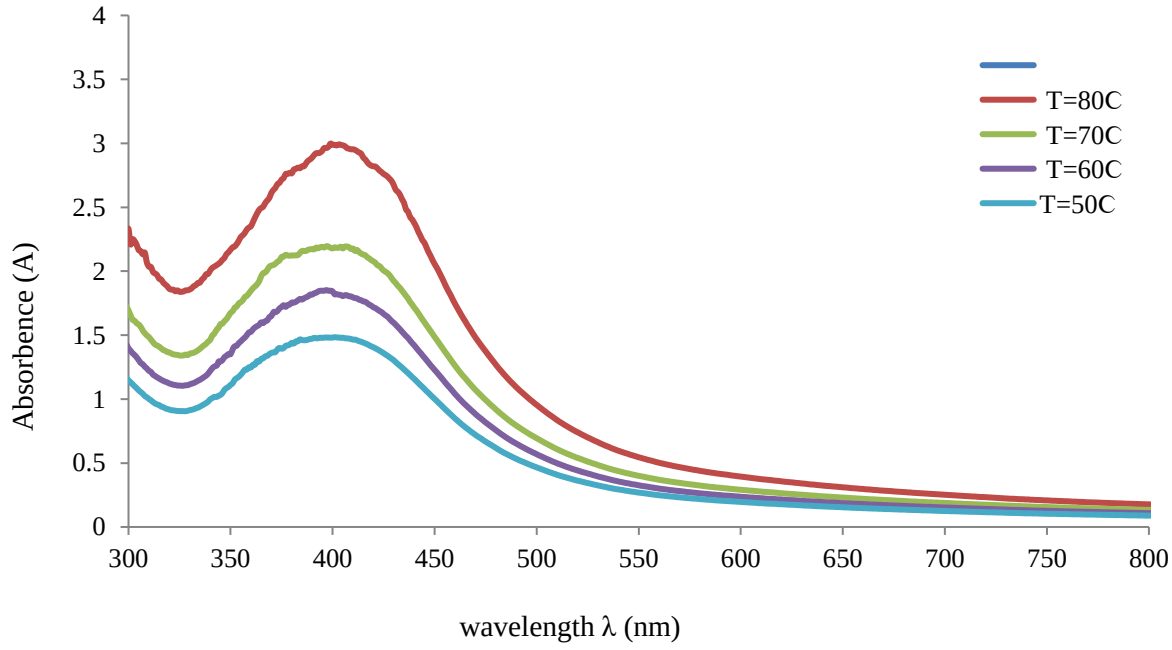

Figure 3: Silver nanoparticles (Ag -NPs) surface plasmon resonances (SPR) at different temperatures exhibit their best absorbance in the region of the blue shift

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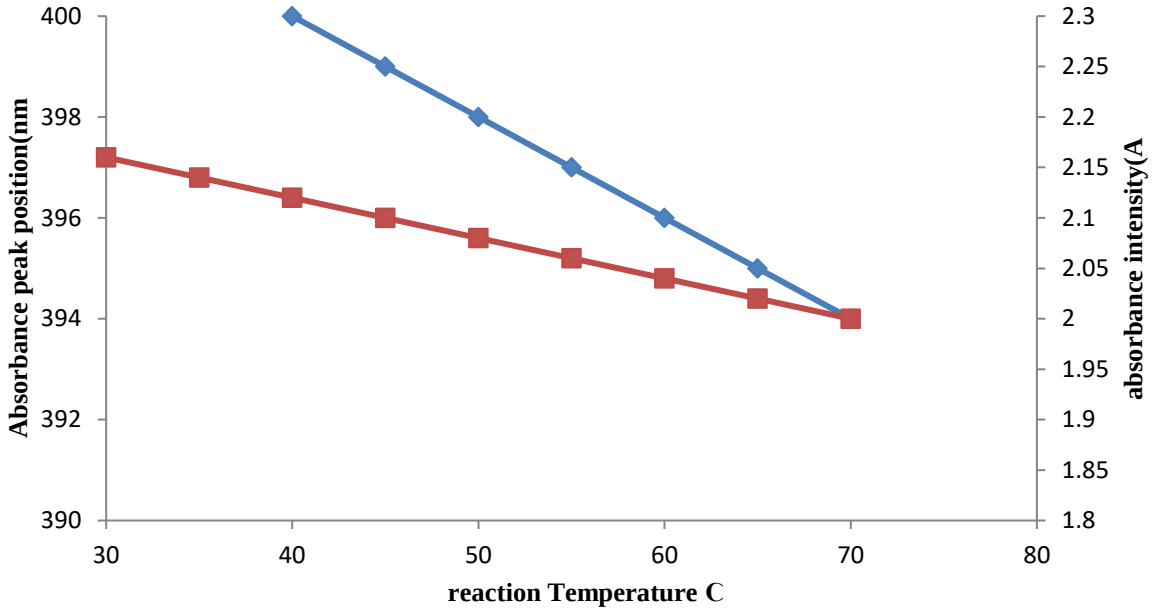

Figure (4). Silver nanoparticle surface plasmon resonance (SPR) absorbance peak position and intensity as a function of reaction temperature.

Different times (30,40,50,60min) were taken for sample preparation (S1,S2,S3,S4) in the third stage of samples preparation, where the reaction time taken to prepare the sample S1=30min, the second sample S2=40min, the third sample S3=50min, and the fourth sample S4=60min, and we discovered that preparation time (45) min is the optimal time to achieve the highest absorption peak and achieve the blue shift of (Ag-NPs) pure coloscopy of (Ag) nanoparticles at the optimum preparation period is shown in Figure (5).

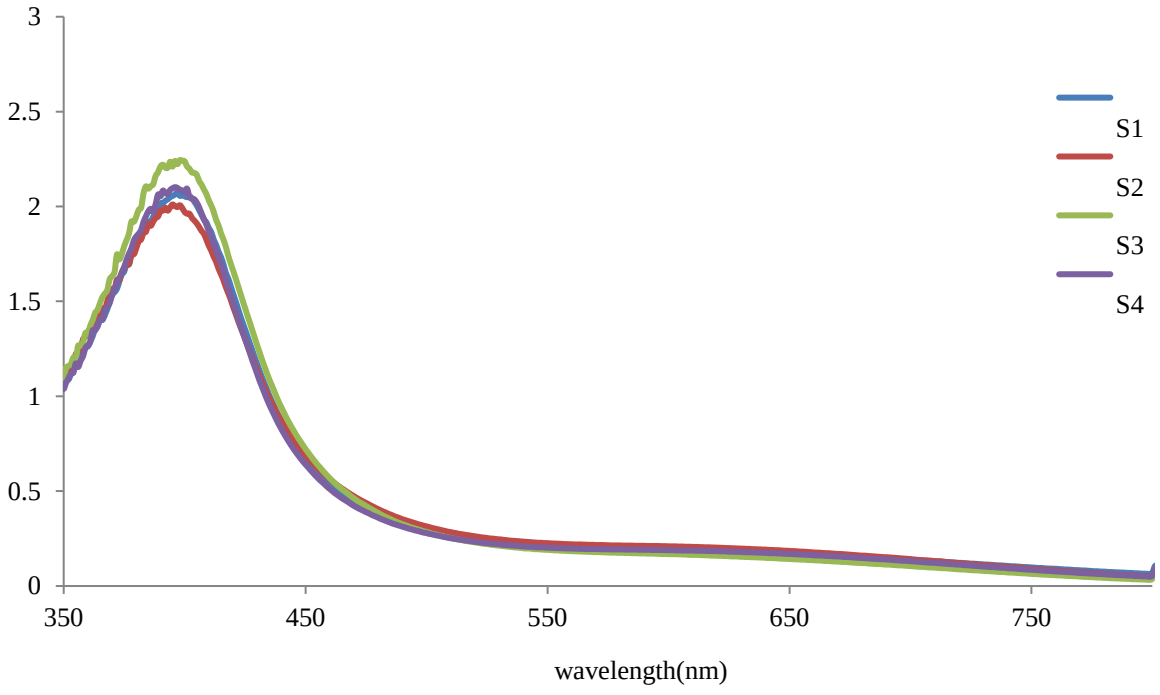

Figure 5: Optimal absorbance of silver nanoparticles (Ag-NPs') surface plasmon resonances (SPR) in the blue shift region at various reaction times.

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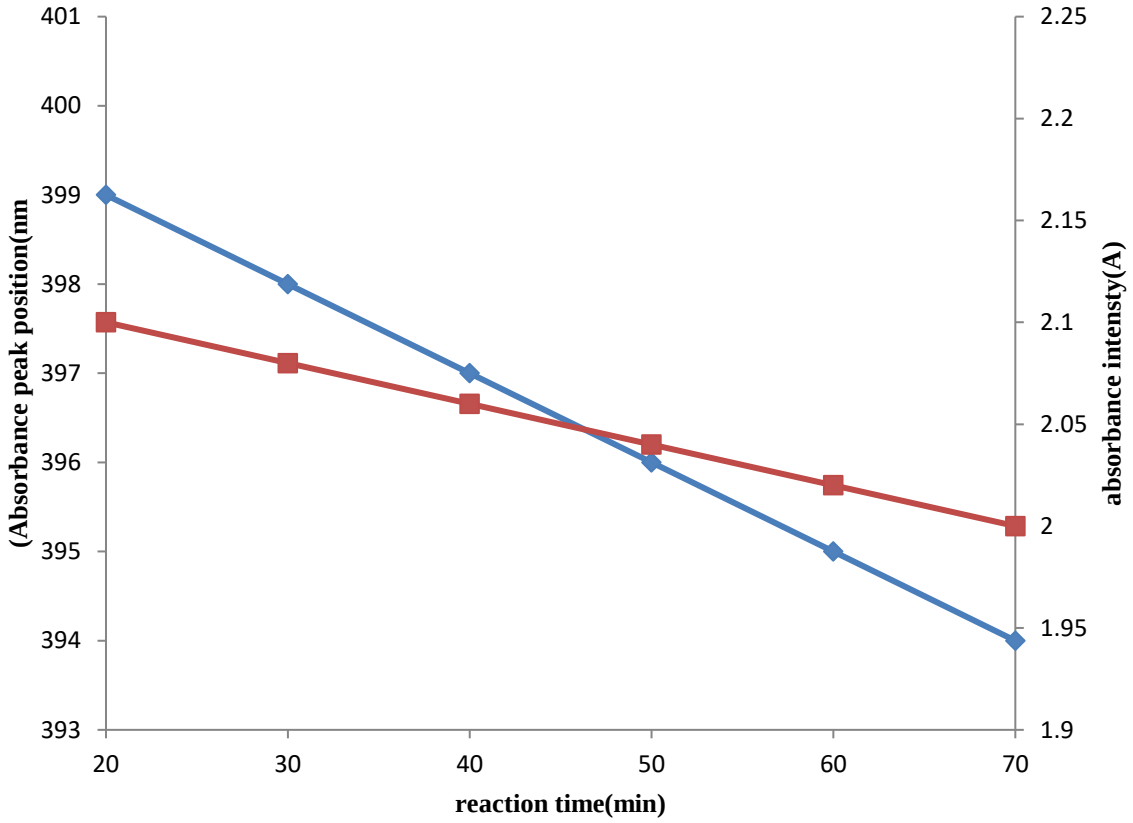

Figure 6: Silver nanoparticle surface plasmon resonance (SPR) absorbance peak position and intensity with response time.

4. 2. Crystalline Structure (XRD)

The Figures Show the (XRD) assay of the compound Ag Nanoparticle prepared using different precursors , the (XRD) plot shows the characteristic peaks of each sample, the schemes show that the distinctive peaks are limited to the angles 2θ = (45.35,44.27,43.79,38.02,35.22) and with different intensities, Since each peak has its own Millers coefficient, the grain size ranges between (26.66-197.5nm), The From the X-ray line broadening, the crystallite size was calculated using the Scherrer formula [18].

Table 1: The structural of (Ag-NPs) Within reaction Time at (45 min), reaction temperatures (70C), and (PH) Concentration=10 and material Concentration =($AgNO_3$=0.009g, Gallic aced=0.02g)

20	D(Å)	I(a-u)	FWHM(Degree)	Grain size (nm)
45.35	1.99	47	0.28000	53.66
38.02	2.36	78	0.35000	41.66
44.27	2.04	20	0.24000	62.36
38.25	2.35	63	0.07430	197.5
35.22	2.54	44	0.09600	151.5
38.04	2.36	100	0,46000	31.88
43.79	2.06	100	0.56000	26.66

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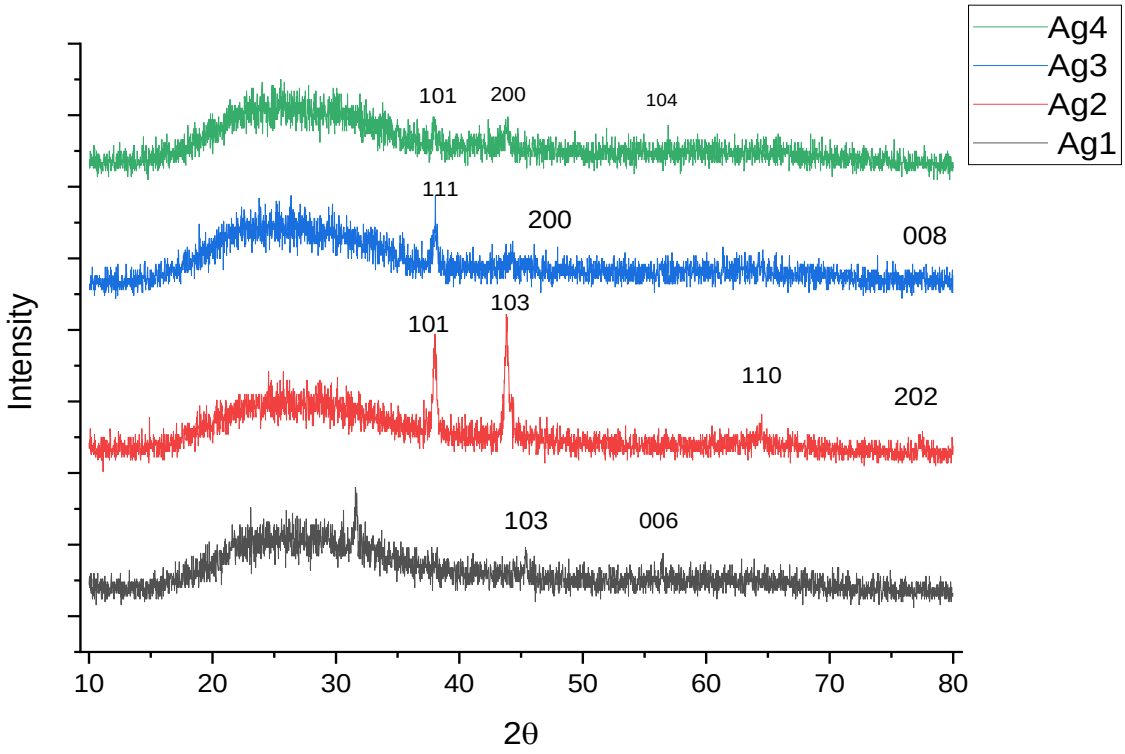

Figure 7: XRD Pattern of Silver Nanoparticles (Ag-NPs).

4. 3. Microscopic studies (FESEM)

Figures (8,9,10,11) showed the image of (Ag) S1, S2, S3, and S4-differentially generated NPs in the pictures It seems that Ag particles composed of small particles of FESEM are the greatest instrument for examining the structural and morphological characteristics of synthetic materials, The pictures show the homogeneous distribution of Ag Nanoparticles, As may be seen , the mean particle size of Ag is about (26.6 - 62) nm , and the nanoparticles have a good homogeneity , and clusters of grapes , SEM analysis shows that there is match with XRD analysis.

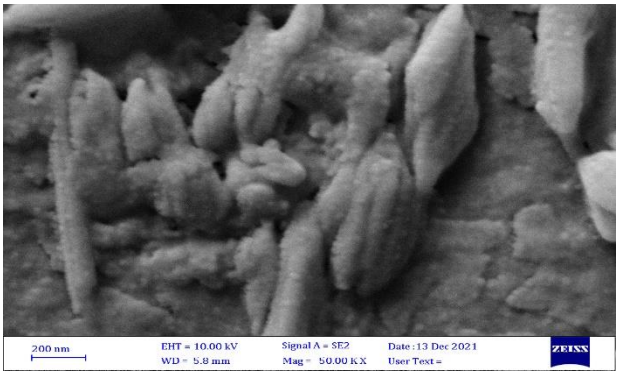

Figure 8: FESEM picture of (Ag-NPs) Manufactured using different concentrations ($AgNO_3$=0.009g) and (Gallic aced=0.02g).

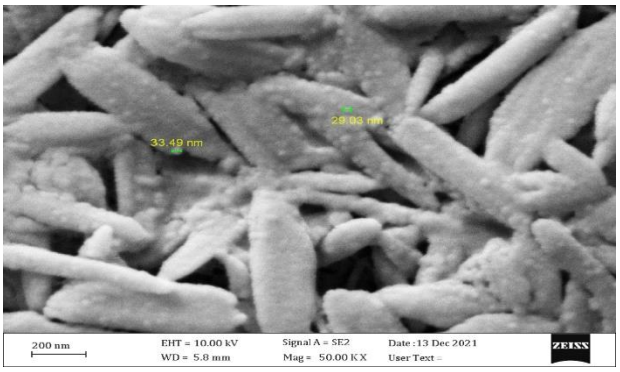

Figure 9: FESEM picture of (Ag-NPs) Manufactured using the optimum (pH=10) value.

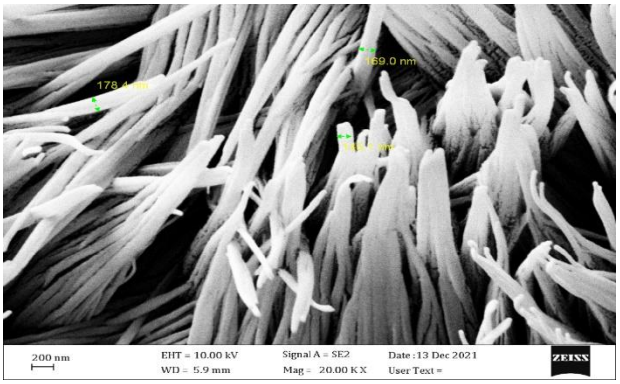

Figure 10: FESEM picture of (Ag-NPs) Manufactured using optimum reaction temperature =(70C).

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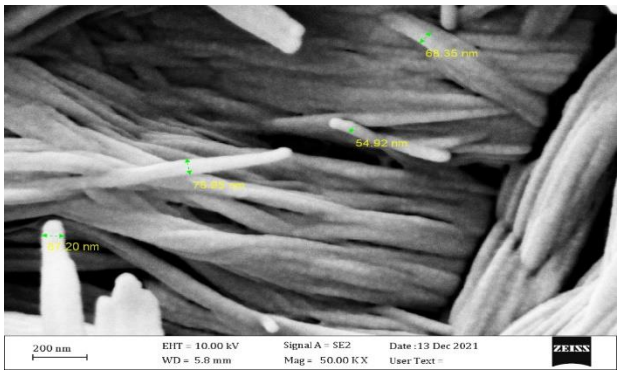

Figure 11: FESEM picture of (Ag-NPs) Manufactured using the optimum value of reaction time=(45min).

V. CONCLUSIONS

Silver nanoparticles were prepared in this study using a chemical method, which is a sample, effective, and cost-effective method. Analyses revealed that the size of (Ag-NPs) crystals is dependent on the reaction time and reaction temperature and concentrations (PH), Ultraviolet–Visible spectroscopy revealed that Ag nanoparticles have a blue shift at (400nm), and SEM and XRD analyses revealed that (Ag-NPs) Similar to clusters of grapes.

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