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"Development of High Speed Method for Preparing Nanoparticales Using Electrical Arc Discharge to Be Used in Water Treatment"

A Thesis

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In

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By

Amna Said Mohamed Ali

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SUMMARY

Nanotechnology has become an important science in order to enhance the potential of many applications. Double arc discharge method was demonstrated in this work to be an effective method for the fabrication of nanoparticles with different types of electrode materials. The prepared nanoparticles were characterized using different morphological, composition and structural types of characterization. Study the electrical discharges generated in liquids have a unique position among the non-thermal plasma sources. Comparing to plasmas in gases, they required special conditions for their ignition due to substantially different properties of ionized medium. Plasmas in liquids can be generated in devices with different electrode configuration. Further, various voltage regimes can be applied for the discharge. These alternatives allow plasma generation in many possible variants. Therefore, each plasma device requires its own optimal set of experimental conditions for a particular application. Based on these processes, electrical discharges in liquids are applied in many technologies. Copper, carbon and silver nanoparticles have become ones of the most important functional materials in modern science due to their excellent physical properties. The purpose of this thesis is to conduct a comparative study to investigate the effect of relevant different parameters that affect the nanoparticles yield rate, structure and quality during their production using a double AC arc plasma technique in de-ionized water .The set-up constructed spastically for this propose .The effect of the current potential and intensity ,the purity of the materials which can be used as rods source and the combination of the electrode sizes on the yield rate of both Cu NPs ,C NPs and Ag NPs have been studied. The three produced nanoparticles have then investigated using scan electron microscope (SEM), X-ray diffraction (XRD), Transmission electron microscope (TEM), Fourier transform infrared (FTIR) spectroscopy analysis, particle size analyzer (PSA), The ultraviolet-visible (UV-Vis).Also, it is contributed to the analysis of size and optical properties of these nanoparticles through each applied current value (ranges from 30-110A). The best production for the nanoparticles have been applied in water treatment technique. The final results shows that these nanoparticles are suitable to be prepared with different sizes. However, a scale-up of production rate often leads to an increase in particle size and broadening of size distribution. The structural analysis is confirmed that the double arc discharge technique synthesis of NPs was stable. It is an easy, fast technique and does not involve any harmful or toxic chemicals. It is also stable and accurate enough to be applied at different ranges of currents. The prepared Cu and Ag NPs showed efficient anti-bacterial activity against E. coli. The results indicated, almost all treated bacteria cells were dead with 5000 μg mL^{-1} Cu nanoparticles and showed significance differences between inhibition of growth cells by different amount of Cu or Ag NPs. As the concentration of the nanoparticles increases the number of colonies will decreased. The antibacterial activities of the Ag-NPs against Gram negative E. coli were almost similar to the behavior of CuNPs. The number of colonies grown on the agar was counted. After all cultures were incubated at 37oC for one day, we notice that at the highest concentration 5000 μg/ml the growth of the culture is completely inhibited visible growth. When 2000,3000 and 4000 μg/ml Ag-NPs powder were used, growth was inhibited; however, when 1000 μg/ml Ag-NPs was used, growth was only slightly inhibited.

The dielectric properties of CNPs show better values for the dielectric permittivity and loss at 30A due to its smaller particle size (20-35 nm) which also reveals a good ac

conductivity at room temperature and with a frequency range of 50 Hz to 8 MHz high. It is seen that the dielectric constant of the carbon nanoparticles is much lower and also there is no much variation at high frequencies. It can also be seen that dielectric loss decreases with increased frequency and at higher frequencies the loss angle has almost the same value. In dielectric materials, generally dielectric losses take place due to absorption current.