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Effect of Current on Plasma Parameters Resulting from the Wires-Exploding Technique of Copper Material

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***Abstract*- In this research the diagnostic of optical emission spectroscopy from exploding copper wires have done for different current. By using Boltzman plot can be calculated the plasma electron temperature T_e, and by using Stark broadening can be evaluated the electron density n_e for different current of (75, 100 and 150)A with diameter 0.25 mm in deionized water. It was observed that the electron density n_e decrease with an increasing the current from 75 A to 150 A while the electron temperatures increase for the same current. The plasma has a peak 652 nm corresponding to Hα line for .hydrogen .atoms which obtained from .optical emission spectrum (OES), the peaks belong to atomic copper lines. The plasma electron temperature related with emission line intensity and number .density with the formed copper nanoparticles size was studied.**

***Keywords*-Plasma, OES , Exploding wire**

I. Introduction

The alludes nano (began) from the Greek (nanos) which, signifies 'overshadow'. It is one Billionth of a meter (1× 〖10〗^(- 9) m). Consequently, at whatever point we consider nanoscience or nanotechnology, exceptionally little articles strike a chord. Truth be told, this part of science and innovation manages materials having at any rate one spatial measurement in the size scope of (1 – 100) nm, (Ozin, 2006).

Richard P. Feynman (Nobel Laureate in Material science, 1965 is frequently credited for presenting the idea of nanotechnology around 50 years prior. In the yearly gathering of the American Physical Society at California Establishment of Innovation on 26 December 1959, he conveyed a popular address entitled "There's A lot of Room at the Base". In this. address, he talked. about composition twenty. four volumes, (Feynman, 1965).
An essential enthusiasm for the idea of nanotechnology originates from its associations with science. The littlest types of life, microorganisms, cells, and the dynamic parts of living cells of science, have sizes in the nanometer run.

Nanotechnology can be characterized as the capacity to make, control and control questions on nano scale with the point of delivering novel materials that have explicit properties (functionalized materials). These nanomaterials may have diverse nano shapes, for example, nanorod or nanowire and nanotube, (Prasanta, 2009).

Nanotechnology is the plan, creation and utilization of nanostructures or nanomaterials and the major comprehension of the connections between physical properties or marvels what's more, material measurements. Nanotechnology too guarantees the likelihood of making nanostructures of metastable stages with non–customary properties including superconductivity and attraction, (Carl, 2007). There are two ways to deal with the combination of nanomaterials: base up and top - down. In the base up approach, atomic segments organize themselves into additional complex gatherings iota by-particle, atom by-atom, bunch by group from the base (e.g., development of a gem), (Ghosh, 2009). In the top-down methodology, nanoscale gadgets are made by utilizing bigger, remotely-controlled gadgets to coordinate their gathering. The top-down approach regularly employments the conventional workshop or then again microfabrication strategies in which remotely controlled instruments are utilized to cut, plant and shape materials into the ideal shape and request. Wearing down and processing for making nanoparticles are average top-down procedures. Base up. approaches, conversely, orchestrate sub-atomic parts themselves into a few valuable compliance utilizing the idea of sub-atomic self-get together. Blend of nanoparticles by colloid scatterings is a model of the base up approach. A methodology where both these procedures are utilized is known as a half breed approach. Lithography is a model in which the development of slender film is a base up strategy while tingling is a top-down strategy, (Sileikaite, 2006).

II. Experimental Work

1. Exploding Wire System:

In this investigation, the subtleties of .exploratory systems is depicted. By detonating copper wires, with various measurements and distinctive ebb and flow, in deionized water. The plasma parameters were contemplated by optical emanation spectroscopy (OES) contingent upon the radiated light from the copper plasma tuft.

Detonating Cu wires. in deionized. water with various ebb and flow (75, 100, 150)An utilizing .DC power supply with 28V in 0.25 dimeter. After many detonating process. in arrangement..

We utilized DC welding have two terminal: the negative terminal to the wire by another ohmic association and from the positive terminal to the metal plate by an ohmic association. The first terminal (the metal plate 40 x 20 x 2 mm) is associated with one terminal of 28 V DC battery, while as the subsequent terminal is associated to the wire (as a subsequent cathode) which to be detonated, see figure 1.

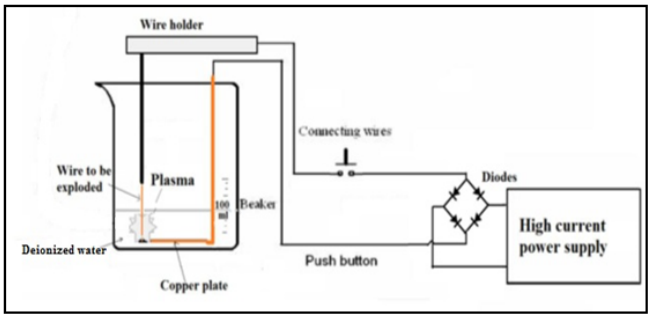


Figure (1): Diagram of the electro-exploding wire.

We utilized A 500 ml measuring glass as vessel. It is vital to keep the room between the wire holder also, metal plate.
The metal plate are fixed on the base of put in glass vessel that filled by 100 ml of deionized water. At the point when simply contacting the principal terminal, through exact mechanical development. The wire blast system happen for extremely brief time, after the contact is occurred between the wire and the plate.
The Cu nanoparticles. scattered in the deionized. water. We can. utilize the referenced. length of wire. for a few contacts, at that point. we supplanted it. The deionized. water contained the Cu NPs as. colloidal structure.

2. Deionized Water:

Deionized. water was used to preparation. of all samples and solution. in this work. Even .such water is .entirely pure; however, it is .contaminated by salts ions. Deionized .water was .prepared in .laboratory in glass .containers avoid the contamination.

III. Results and Discussion

Figure 2 demonstrates the OES for plasma delivered by detonating of various flows (75, 100, 150) A, copper wires and steady width of 0.25 mm.

A strong peak situated at about 652 nm comparing to Hα line for hydrogen atoms produced from water molecular dissociate. Likewise, a small peak appear at 575 nm comparing to sodium,(Jafri,2016)originates from the impurity. It can. be observed. that the. intensities. of peaks increase. With increasing the density of current. This. result . is in accept . with. Wankhede,(Wankhede,2013).

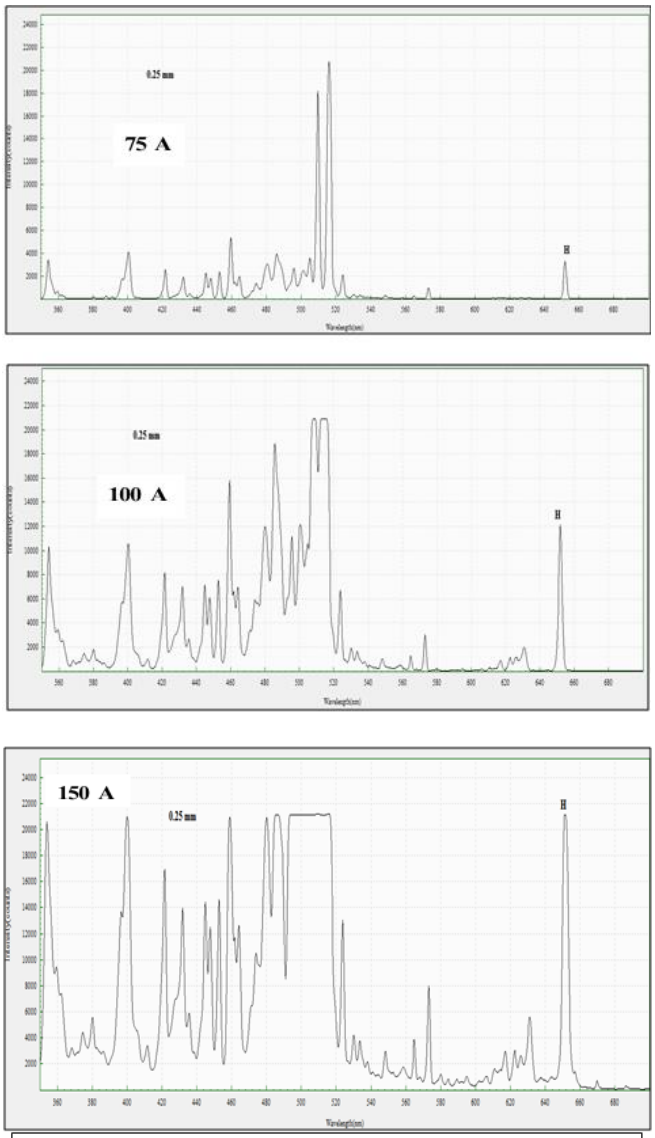
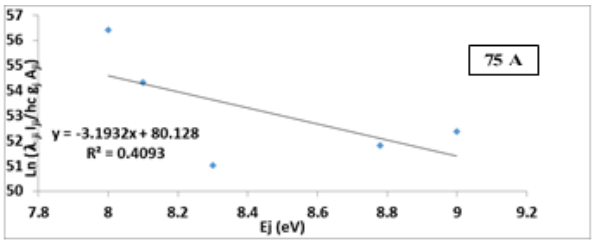
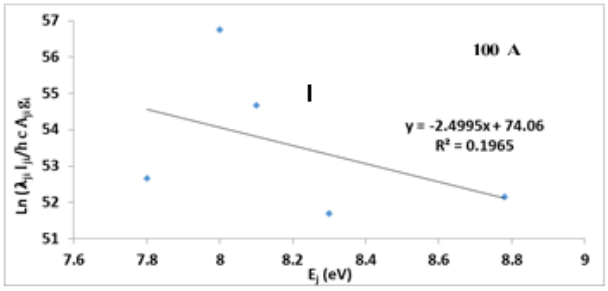


Figure (2): Emission spectra for copper wire with differentCurrent by exploding wire and 0.25 mm diameter.

The electron temperature T_e were calculated by Boltzman plot using five of Cu lines at (400, 422, 453, 459, 480) nm for the different currents, as shown in figure 3. The T_e values were calculated using the relation between $Ln(\frac{I_{ji}\lambda_{ji}}{h\,c\,g_j A_{ji}})$ versus upper energy level (E_j). The equations of fitting lines and the R^2 were shown in the figure. R^2 is a. statistical . coefficient. indicating. the goodness of the linear. fit. which takes a value . between (0, 1), where values closer to1 is the . best one. The figure shows that the value of R^2 varies from 0.321 to 0.4235.





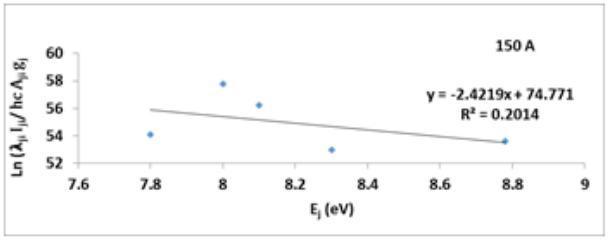


Figure (3): Boltzmann plot from five Cu lines produced by exploding wire with 0.25 mm

Fig. 4 demonstrates the 652 nm hydrogen. Line top profile. The FWHM can by utilizing.Gaussian. fitting . to assessed the density of electron for various tests can using. Stark effect depending on the standard values

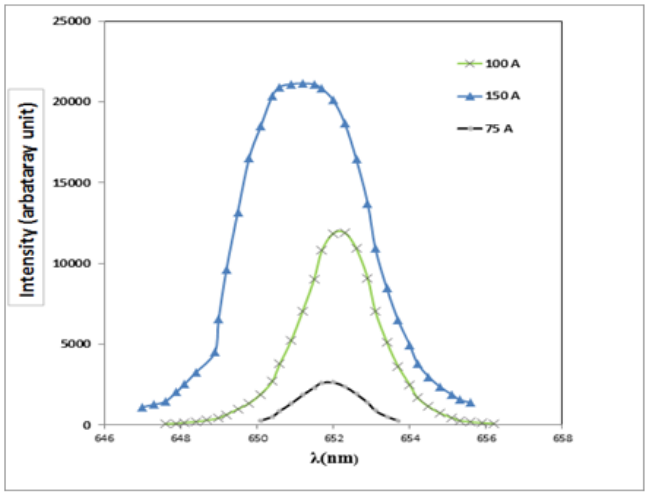


Figure (4):H 652.279 nm peaks broadening and there Gaussian fitting for different wire diameters and current of 0.25 mm

The variation.of temperature of electron T_e and.density of electron n with current were shown in Fig. 5 and Fig.6. This figure shows that ne decrease from 27.4313×10^{17} cm^{-3} to 24.0353×10^{17} cm^{-3} with increasing current from (75) A to (150) A. This result is agree with Wankhede, (Wankhede,2013). The decrement in concentration cause decreasing in collision which caused to increase in electron temperature, where the electron temperatures lose by different ways (elastic, excitation and ionization collisions).

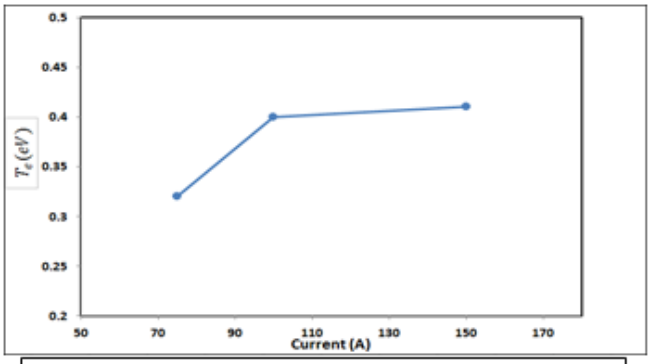
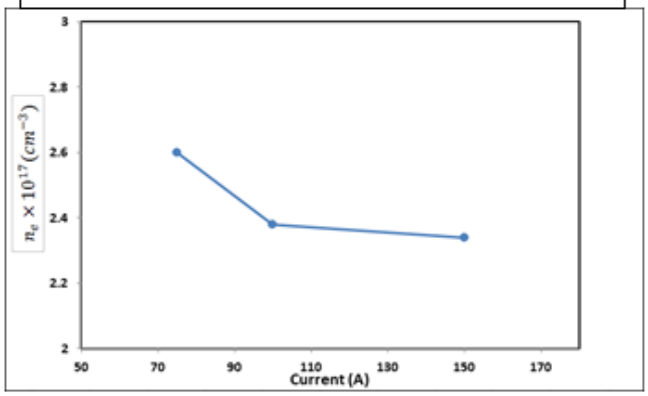


Figure (5): The variation of T_e for different current copper wires and 0.25 mm



IV. Conclusions

The wire explosion technique is ecologically safe, pollution free process, which is desirable for our environment protection.

1. The electron density in the plasma measured decrease with increase current.
2. The plasma temperature measured increase when the current of the wire is increase.
3. Higher energy with the lower wire diameter should be preferred for finer size nanoparticles.
4. There is a relationship between the density of electrons in the plasma and the number of particles measured by atomic absorption and generated by the detonation of wires.

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