Journal of Education and Scientific Studies Chemistry Science
JESCS Vol. 15, No. 1, January 2020, ISSN 2413 - 4759

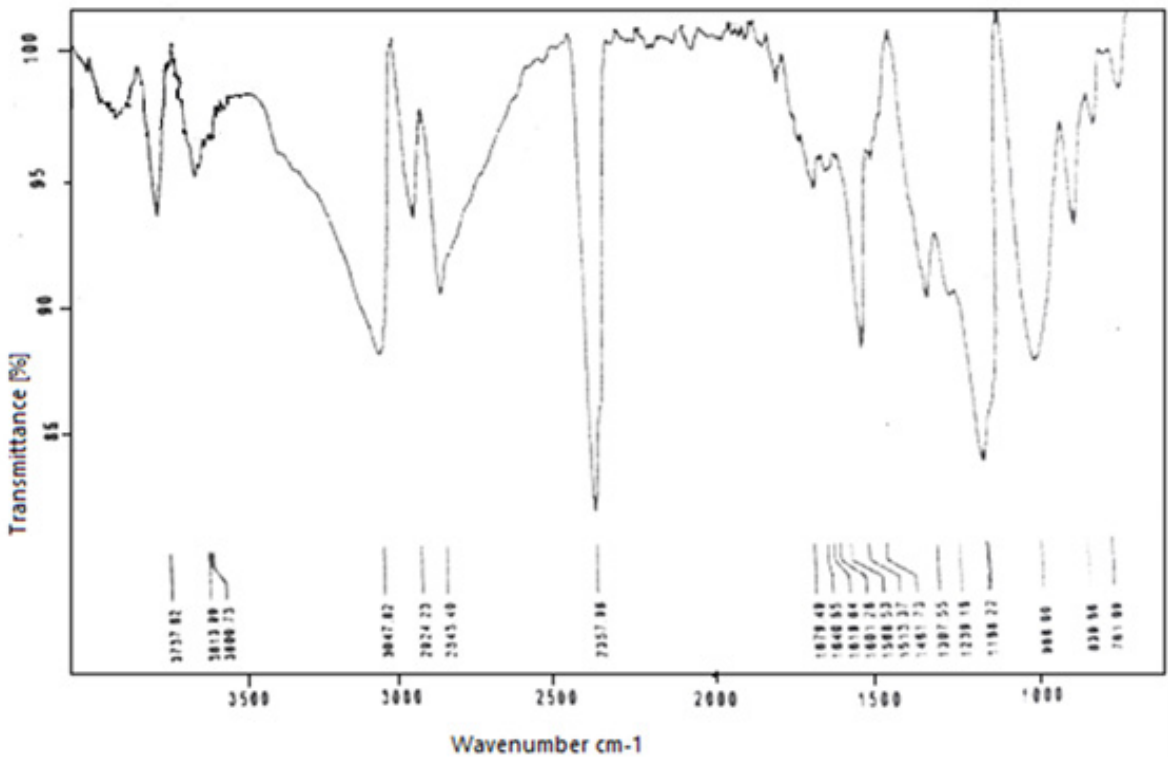


**Fig.4 :** FTIR for graphene oxide

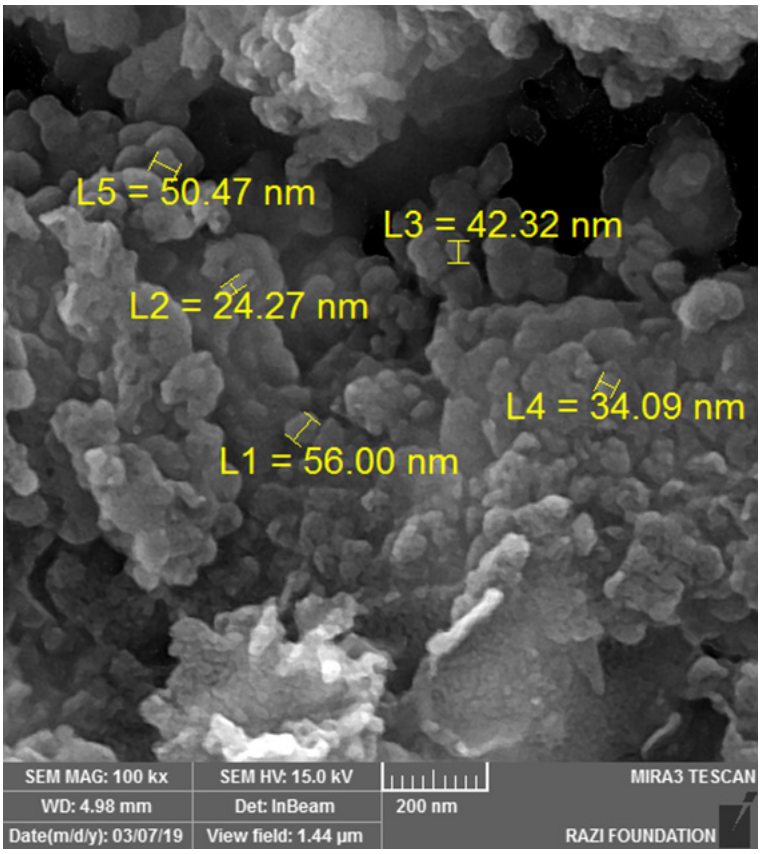


**Fig. (2-B):** FE- SEM photographs of CNs grown on ZnO (200 nm)

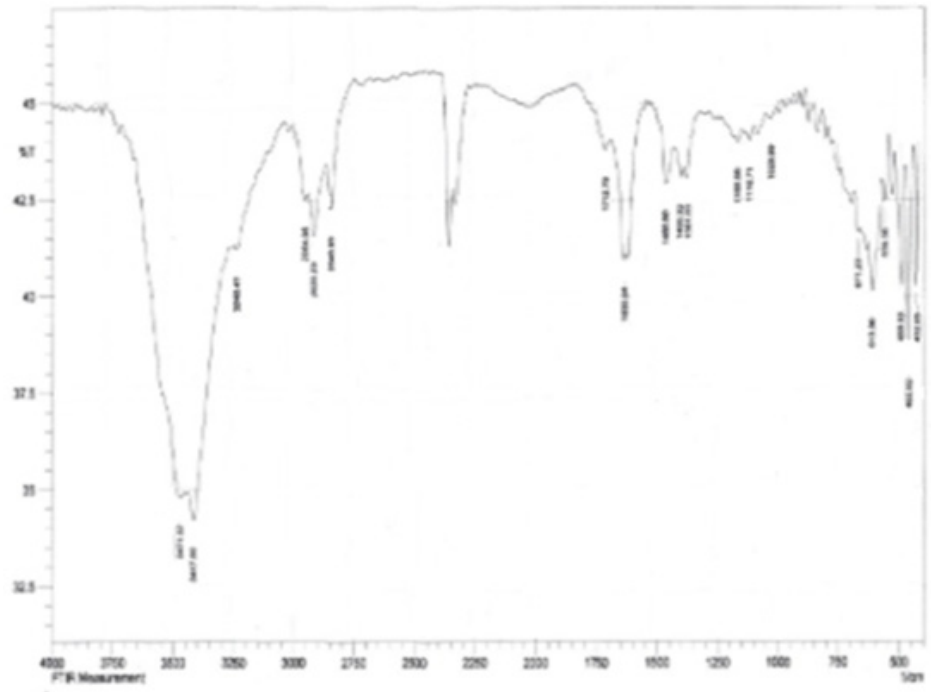

**Fig.3:** FTIR Spectrum for polypropylene

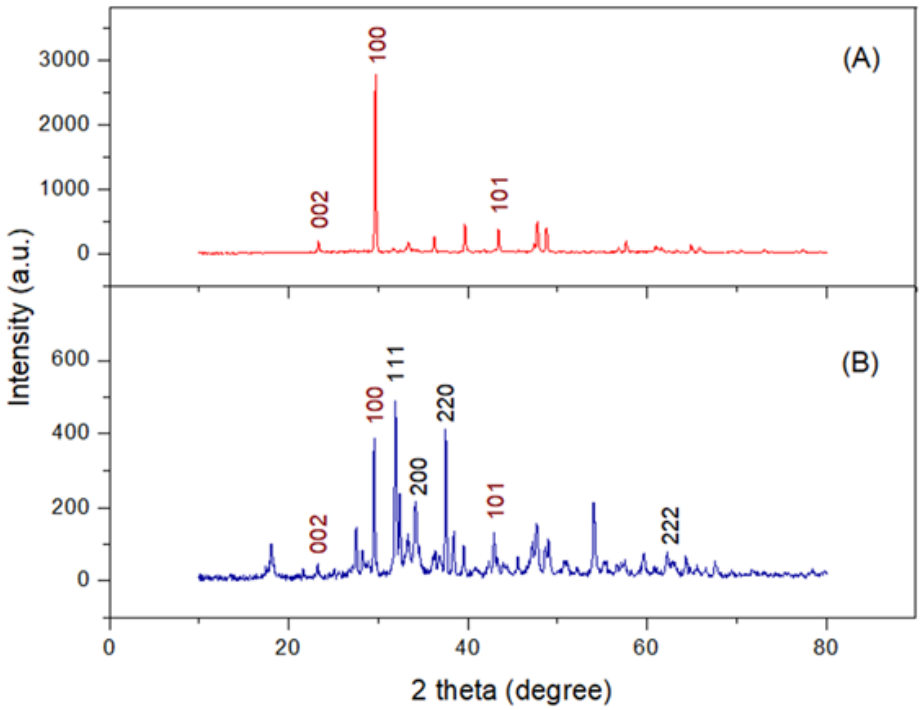


**Fig.1:** XRD diffraction pattern of CNs

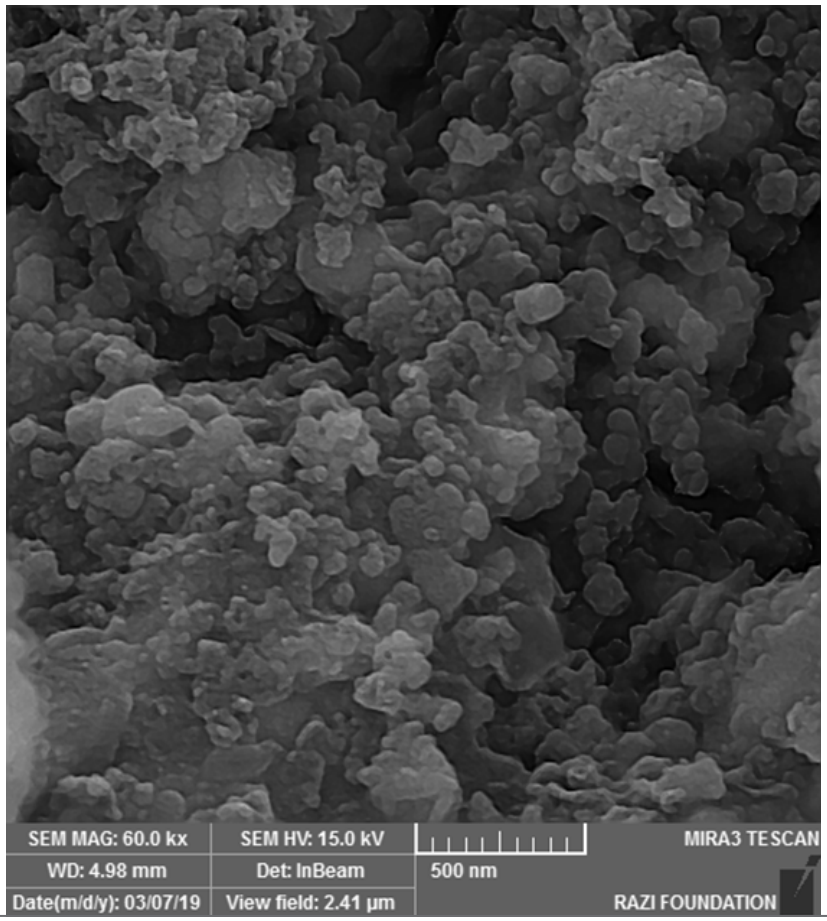


**Fig. (2-A):** FE- SEM photographs of CNs grown on ZnO (500 nm)

plastic waste into carbon nanotubes." Journal of environmental monitoring 12, no. 2 (2010): 455 - 459.

[12] Girgis, Badie S., Yassin M. Temerk, Mostafa M. Gadelrab, and Ibrahim D. Abdullah. "X-ray diffraction patterns of activated carbons prepared under various conditions." Carbon letters 8, no. 2 (2007): 95 - 100.

[13] Wulan, P. P. D. K., and K. D. Cendana. "Synthesis of Nanocarbon from Polyethylene Plastic using Stainless Steel Catalyst via Oxidative Heat Treatment Preparation Method." International Journal Sustainable Future for Human Security (2016): 16 - 21.

[14] Bharti, Dattatraya B., and A. V. Bharati. "Synthesis of ZnO nanoparticles using a hydrothermal method and a study its optical activity." Luminescence 32, no. 3 (2017): 317 - 320.

[15] Balsamo, M., S. Cimino, G. De Falco, A. Erto, and L. Lisi. "ZnO-CuO supported on activated carbon for H2S removal at room temperature." Chemical Engineering Journal 304 (2016): 399 - 407.

[16] Das, Rasel, Sharifah Bee Abd Hamid, Eaqub Ali, Seeram Ramakrishna, and Wu Yongzhi. "Carbon nanotubes characterization by X-ray powder diffraction–a review." Current Nanoscience 11, no. 1 (2015): 23 - 35.

Presence of Waste Plastics in the Degradation of Municipal Solid Waste in Landfill." In Waste Valorisation and Recycling, pp. 93-103. Springer, Singapore, 2019.

[4] Huang, Pengke, Fei Wu, Yongyan Pang, Minghui Wu, Xiaoqin Lan, Haibin Luo, Bin Shen, and Wenge Zheng. "Enhanced dispersion, flame retardancy and mechanical properties of polypropylene / intumescent flame - retardant composites via supercritical CO2 foaming followed by defoaming." Composites Science and Technology 171 (2019): 282-290.

[5] Deng, Junjiao, Yi You, Veena Sahajwalla, and Rakesh K. Joshi. "Transforming waste into carbon-based nanomaterials." Carbon 96 (2016): 105 - 115.

[6] Alston, Sue M., Allan D. Clark, J. Cris Arnold, and Bridget K. Stein. "Environmental impact of pyrolysis of mixed WEEE plastics part 1: experimental pyrolysis data." Environmental science & technology 45, no. 21 (2011): 93809385-.

[7] Reddy, Naveen Krishna, Jean-Luc Meunier, and Sylvain Coulombe. "Growth of carbon nanotubes directly on a nickel surface by thermal CVD." Materials Letters 60, no. 29- 30 (2006): 3761 - 3765.

[8] Fang, Liang, Yanping Xie, Yueyue Wang, Zongwen Zhang, Peifang Liu, Nian Cheng, Jiangfeng Liu, Youchao Tu, Hongbin Zhao, and Jiujun Zhang. "Facile synthesis of hierarchical porous carbon nanorods for supercapacitors application." Applied Surface Science 464 (2019): 479 - 487.

[9] Chhowalla, Manish, K. B. K. Teo, C. Ducati, N. L. Rupesinghe, G. A. J. Amaratunga, A. C. Ferrari, D. Roy, J. Robertson, and W. I. Milne. "Growth process conditions of vertically aligned carbon nanotubes using plasma enhanced chemical vapor deposition." Journal of applied physics 90, no. 10 (2001): 5308 - 5317.

[10] Jiang, Zhiwei, Rongjun Song, Wuguo Bi, Jun Lu, and Tao Tang. "Polypropylene as a carbon source for the synthesis of multi-walled carbon nanotubes via catalytic combustion." Carbon 45, no. 2 (2007): 449 - 458.

[11] Pol, Vilas Ganpat, and Pappanan Thiyagarajan. "Remediating

**Tab.2. Shows the effective locations of PP before pyrolysis and PP after pyrolysis (Graphene Oxide).**

| PLASTIC WASTES | υ(N-H) | υ(=C-H) alkene, aromatic | υ(C-H) alkan, alkene | υ(C=O) carboxylic acid | υ(C=C) alkene, aromatic | υ(C-C) in the ring | δ(C-H) scissoring | δ (C-H) rocking | υ(C-O) | δ(=C-H) bending |
|---|---|---|---|---|---|---|---|---|---|---|
| PP | ,3464 3417 | 3074 | ,2958 ,2924 2854 | --- | 1643 | --- | 1462 | 1377 | --- | ,968 ,887 705 |
| Graphene | ,3813 3600 | 3047 | .2924 .232843 40 | --- | 1619 | --- | 1461 | 1307 | --- | ,988 ,839 761 |

## 4. Conclusions

We conclude from this research that the temperature of the pyrolysis of polypropylene is at 400 ° C for about 30 minutes and the result of XRD and FESEM shows there is carbon nanostructure at all temperatures and marked by a peak intensity at 2θ = 23º, 28.5º and 43º.

**Acknowledgements**

The authors gratefully acknowledge the supports from University of Anbar, College of Science, Department of Chemistry.

## Reference

[1] Shiri, Noel Deepak, Myriam Shankar Krafft, and Wolfram Thurm. “Plastic lumber product development using commingled waste plastics.” In AIP Conference Proceedings, vol. 2080, no. 1, p. 050007. AIP Publishing, 2019.

[2] Spokas, K., Jean Bogner, J. P. Chanton, M. Morcet, C. Aran, C. Graff, Y. Moreau-Le Golvan, and I. Hebe. “Methane mass balance at three landfill sites: What is the efficiency of capture by gas collection systems?.” Waste management 26, no. 5 (2006): 516 - 525.

[3] Ghosh, Anaya, Jyoti Prakas Sarkar, and Bimal Das. “Effect of Physical

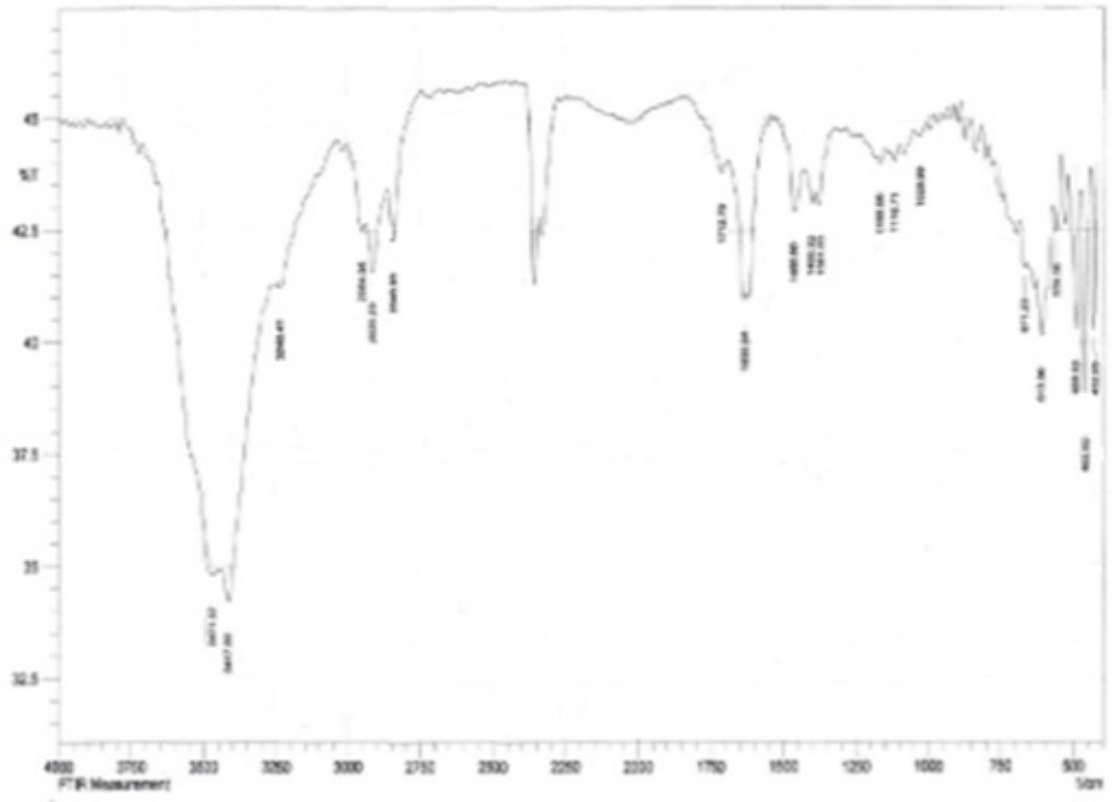

**Fig. 3:** FTIR Spectrum for polypropylene

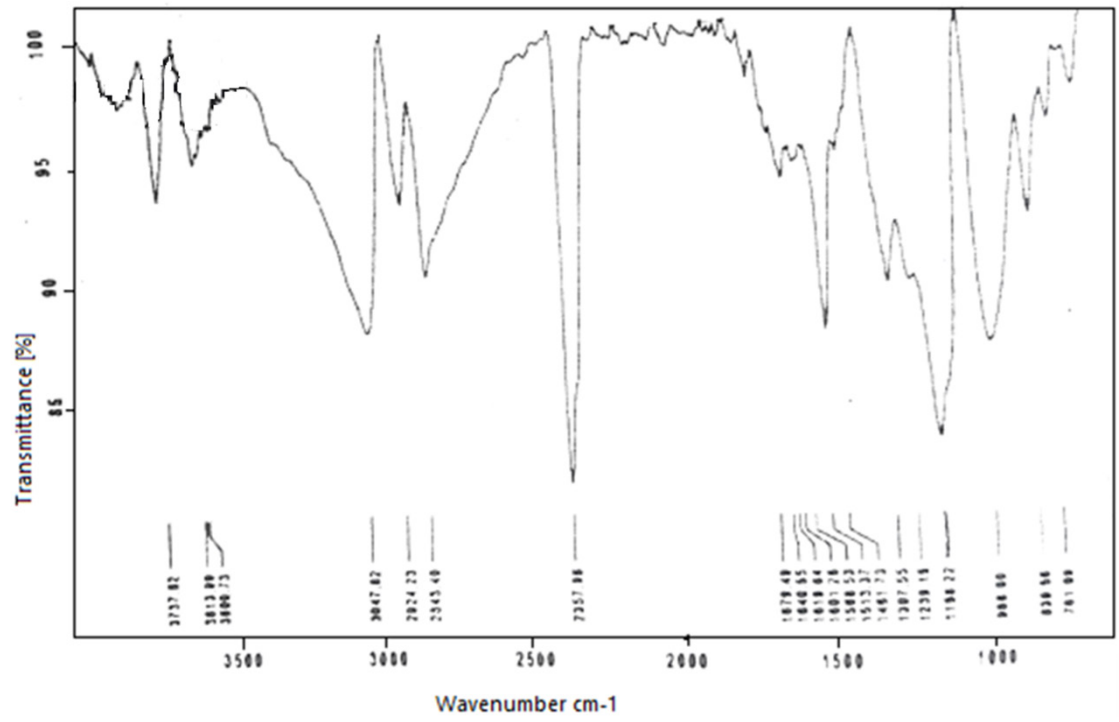


**Fig.4:** FTIR Spectrum for Graphene Oxide

**Tab.1: Structural parameter of Carbon Nano structure (CNs) from PP, (JCPDS Data base, card NO. 41 - 1487).**

| 2θ (deg) | FWHM (deg) | Cos θ | FWHM (rad) | $I/I_1$ | hkI | Crystalline Size (nm) |
|---|---|---|---|---|---|---|
| 23 | 0.09 | 0.979092946 | 0.001570681 | 50 | 002 | 90.30185 |
| 28.5 | 0.2199 | 0.966975415 | 0.003837696 | 451 | 100 | 37.4216 |
| 43.0 | 0.1704 | 0.929472554 | 0.002973822 | 102 | 101 | 50.24084 |

From tab.1, we could calculate the average crystal size of CNs as shown below:

Average crystal size = 59.32 nm.

From fig.1. we notice that the intensity of the peaks at the peak locations (002, 100 and 101) are decreased after the catalyst was added which is confirmed by the FESEM measurements, figures (2-A), (2-B) which shows the formation of carbon nanoparticles.

The morphology of the sample was revealed by FESEM. Fig. 2A shows a typical FESEM image of the sample. It is found that large quantities of nanostructures were obtained. These nanoparticles are carbon (24 - 56) nm in diameter, and a few micrometers in length, as shown in Fig 2B.

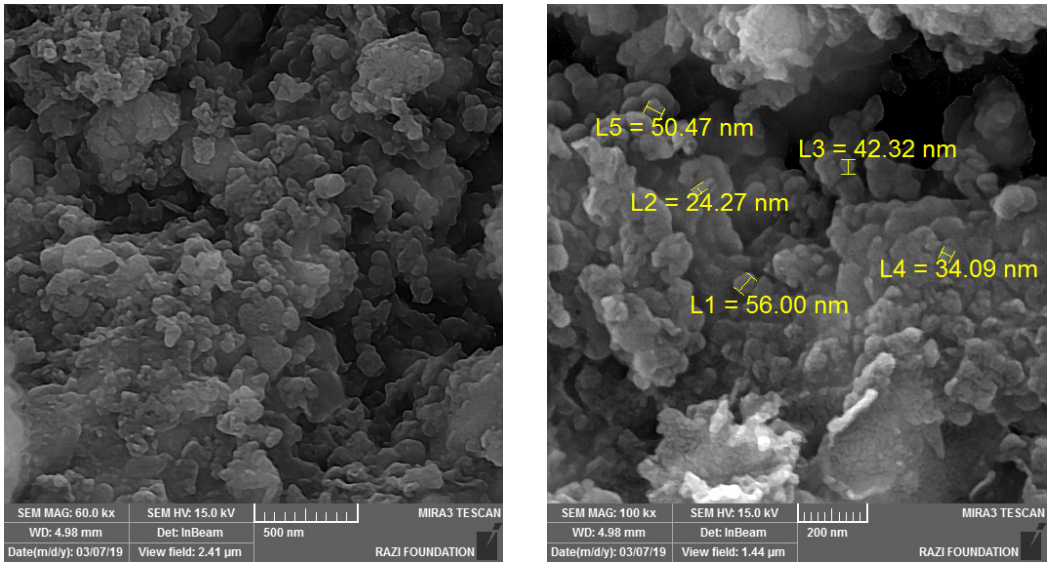


**Fig. 2:** FE- SEM photographs of CNs grown on ZnO (A) 500 nm (B) 200 nm

device for investigating the change of functional groups of the CNs.

## 3. Results and Discussion

**Figure 1** Shows the XRD patterns of the CNs, the diffraction peaks at the value of 23º, 28.5º and 43º were ascribed to the (002), (100) and (101) reflections, respectively of the CNs[12,13], and The ZnO showed peaks corresponding to (111), (200), (220) and (222) planes, indicating the presence of cubic face centered ZnO and the intense peaks were observed at 31.8°, 34.4°, 36.2° and 62.3° can be seen for cubic ZnO phase (JCPDS PDF no. 36–1451) [14, 15].

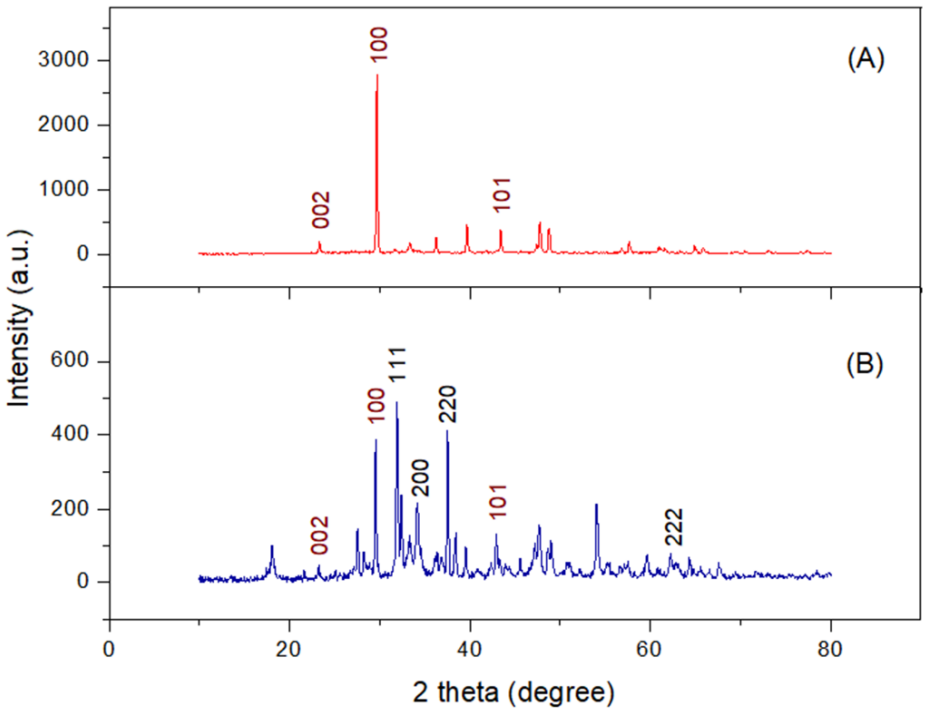


**Fig. 1:** XRD diffraction pattern of CNs. (A) PP without catalyst. (B) PP with ZnO at 1000 ºC for one hour.

Average crystal size in the product that can be found by using X-ray diffraction profile. Calculating the particle size (D) can be done by using the Debye Scherrer equation:

$$D = \frac{K\lambda}{\beta COS\theta} \quad \ldots\ldots [1]$$ [16].

Where is the Scherrer constant, λ is the wavelength of light used for the diffraction, β is the full width at half maximum of the sharp peaks and θ is the angle measured. The Scherrer constant ($K$) in the above formula accounts for the shape of the particle and is generally taken to have the value 0.9 [16].

and catalyst in one reactor. The properties of carbon nanoparticles and the percentage of the product depends mainly on raw materials. For instance, various methods have been developed to produce CNTs such as arc discharge, pyrolysis, laser ablation of carbon, plasma assisted deposition and Chemical Vapor Deposition (CVD) [7,8,9].

## 2. Experimental

### 2.1. Materials and methods

Wastes of polypropylene are collected from local grocery stores, the catalyst (Zinc Oxide) purchase from (BDH company).

25 g of shredded PP is placed inside a stainless-steel reactor. 0.5 g of (ZnO) was placed in tube nozzle connected with reactor. The reactor was tightly closed and put in an electric furnace to be heated. This reactor iscontacted to Condenser and then to three neck flask for product collection. When the temperature of 400 °C was reached and the wastes began to decompose, the catalyst (ZnO) was added from the tube nozzle. At this level the distillation process began and at the end of distillation the temperature was raised to required temperature, 1000 ° C for One hours, then allowed to cool to room temperature naturally. It was found that the final product in the reactor included carbon powder [10,11].

**2. 2. Carbon Nano structure Identification.**

To identify CNs properties, the following equipment's are used:

**1. X-Ray Diffraction (XRD).**

TheX-raydiffraction(XRD,X'PERT PRO from Philips, Netherlands) was evaluated to determine the crystal structure and phase the samples, with Cu-Kα radiation (λ=1.54178 Å), operated at 40 kV and 40 mA, was measured in 2θ range from 10o to 80o, performed on a University of Kashan (Iran).

**2. Field Emission Scanning Electron Microscopy (FESEM):**

The morphology and size of samples were studied by scanning electron microscopy (SEM; FEG-SEM MIRA3 TESCAN, Czech Republic), which is configured to operate at (15.0 kV) various magnification level.

**3. Fourier Transform Infrared (FTIR):**

Spectra was measured by using FTIR (Bruker Company, model VERTEX 70 with Hyperion Scanning Microscope)

## 1. Introduction

Plastic materials are characterized by many properties that make them desirable in practical applications such as low cost, lightness and durability and as a result are necessary in our daily lives [1].

Municipal solid waste is non-degradable and is not implemented in nature. Is disposed of by the way known as landfill, which accumulates multiple types of plastic waste. In these tombs there are many microorganisms that accelerate the degradation of organic matter associated with plastic waste [2].

We can also notice that the amount of plastic consumption is much higher than the average global consumption. The large production of plastic poses a major challenge to deal with these huge quantities of plastic waste after use. Plastic materials in solid waste release harmful chemicals in the soil that can then flow into the groundwater or other surrounding rivers and lakes so it can pose a significant risk to the organisms that drink contaminated water [3].

Polypropylene is an attractive candidate for packaging applications and has a wide popularity in automobile and electronics field due to its excellent advantages of good thermal stability, chemical resistance, easy handling, good mechanical characteristics and inexpensiveness [4].

Waste materials from domestic wastes to industrial remains, rise harmful effects on environmental and human health which regarded a source of air, soil, water and marine pollution. Though, wastes can be used as tools to produce useful goods. A significant technique to obtain this goal is pyrolysis. Pyrolysis relates to thermal decomposition that is operated in an air-free condition [5].

Pyrolysis is a probable alternative to landfill for processing plastic waste, resulting decomposition products which can be used as" fuels instead of gas, diesel or fuel oils" [6]. Additionally, pyrolysis of plastics has also been utilized to manufacture various types of Nano Carbon such as nanotubes, nanofiber, nanorods, nanowires, nanoparticles etc., Carbon nanoparticles which have high value and exceptional physical and chemical properties because of their impressive characteristic like high surface area, porous-rich structure, high conductivity and excellent chemical stability, by blending plastics

doi.org/10.52866/esj.2020.01.15.09

Journal of Education and Scientific Studies Chemistry Science
JESCS Vol. 15, No. 1, January 2020, ISSN 2413 - 4759

# Preparation and characterization of Carbon Nanoparticles from Pyrolysis of Plastic Waste (PP).

Amal shaker Abood[1a*], Ibraheem Jaleel Ibraheem[2b]
Chemical Dept. College of Science, University of Anbar, Ramadi, Iraq
E-mail: [*a] amal990sh@gmail.com, [b] Sc.jaleeli@uoanbar.edu.iq

**Abstract:**

In this research we were synthesized carbon nanoparticles by pyrolysis of plastic waste(pp) at 1000 ° C for one hours in a closed reactor made from stainless steel using zinc oxide (ZnO) as a catalyst. The resultant carbon was purified and characterized by X-ray powder diffraction (XRD). The surface characteristics of carbon Nanostructure were observed with the Field Emission Scanning Electron Microscopy (FESEM). The effective locations of PP before and after pyrolysis were characteristics with the Fourier Transform Infrared (FTIR). The result of XRD and FESEM are showed that carbon is present in Nano figures, at 1000 ° C and with pyrolysis temperature 400° C. One of the advantages of this method is that we have used one reactor for a short time.

**Keywords:** Nano carbon, Plastic waste, characterization, Pyrolysis,

Catalysts, Polypropylene.

# تحضير وتشخيص جسيمات الكربون النانوية الناتجة عن الانحلال الحراري للنفايات البلاستيكية (البولي بروبيلين)

امال شاكر عبود ابراهيم جليل ابراهيم
جامعة الانبار / كلية العلوم - قسم الكيمياء

**خلاصة :**

في هذا البحث تم تخليق جسيمات الكربون النانوية عن طريق الانحلال الحراري للنفايات البلاستيكية عند درجة حرارة 1000 درجة مئوية لمدة ساعة في مفاعل مغلق مصنوع من الفولاذ المقاوم للصدأ باستخدام اكسيد الزنك كمحفز. تم تنقية الكربون الناتج وتمييزه بواسطة حيود الأشعة السينية. وقد لوحظت الخصائص السطحية لهيكل الكربون النانوي بأستخدام المجهر الألكتروني الماسح. كما تم تعيين المواقع الفعالة للبولي بروبيلين قبل وبعد التحلل الحراري بأستخدام طيف الأشعة تحت الحمراء. وأظهرت نتائج حيود الأشعة السينية والمجهر الالكتروني الماسح أن الكربون موجود في الاشكال النانوية، عند 1000 درجة مئوية ومع درجة الانحلال الحراري 400 درجة مئوية. واحدة من مزايا هذه الطريقة هي أننا أستخدمنا مفاعل واحد لفترة زمنية قصيرة.