Chemistry Research Journal, 2018, 3(3):1-6

Available online www.chemrj.org

Research Article

ISSN: 2455-8990
CODEN(USA): CRJHA5

Synthesis and Characteristics of Polystyrene Nanoparticles and Polystyrene Monolayers

Dr. Nabil Abdullah N. Alkadasi[1,2,3], Dr. Abdul Jabar Mohmmed Saleh Al-Eyani[3]

[1]Hubei key lab of Materials Chemistry, School of Chemistry & Chemical Engineering, Huazghong University of Science and Technology, Wuhan, Hubei, 430074 China
[2]Department of Chemistry, Faculty of Education and Science, Al-Baida'a University, P.O. Box: 39189, Yemen
[3]Mechanical Engineering, Faculty of Engineering, Thamar University, Yemen

Abstract In this paper, polystyrene nanoparticles and polystyrene monolayers were successfully synthesized. Polystyrene nanoparticles were carried out, at 80 °C temperature by soap-free emulsion polymerization. Polystyrene monolayers was synthesized from polystyrene nanoparticles. The product of polystyrene nanoparticles shows the best results. While the polystyrene monolayers shows enhancement product. The characterization of Polystyrene nanoparticles and polystyrene monolayers fabrications were done by SEM and TEM.

Keywords Polystyrene Nanoparticles, polystyrene monolayers, Characterization

Introduction

In the previous work, Synthesis and characteristics of Polystyrene nanoparticles and Polystyrene membrane were synthesized [1]. Polystyrene nanoparticles and polymer monolayers have already found a broad range of many applications in fields such as drug delivery, medicine and drug industry. The applications depend strongly on the availability of polystyrene nanoparticles with tightly controlled sizes.

The major components of emulsion polymerization of polystyrene include a monomer (styrene), a dispersion medium (in most cases, water), an emulsifier (surfactant), and an initiator water-soluble.

In this method, synthesis and characteristics of polystyrene nanoparticles to obtained polystyrene monolayers. Synthesis of polystyrene nanoparticles were synthesized using the emulsion polymerization method, followed by a swelling process with another kind of monomer or the same monomer in the presence of an aprotic solvent that is miscible with water [2-6].

Different polymerization of the encapsulated monomer leads to the formation of monodispersed latex nanoparticles. In this paper, I investigated systematically the synthesis and characteristics of polystyrene nanoparticles and polystyrene monolayers, dispersion medium. The size of polystyrene nanoparticles can be controlled in aqueous water dispersion medium. In addition, a seeded growth technique based on aqueous water dispersion media was developed to increase the size of Polystyrene nanoparticles and improve spherical-shape. In comparison to the two-step seed growth technique [7-9], the growth period of my seeded technique is much reduced due to excluding of swelling process of styrene in seed.

Common issues associated with synthesis polystyrene nanoparticles are poly dispersity and meso porous orientation [10-11]. polystyrene nanoparticles with uniform size, shape and composition finds wider applications in industry mono disparity is one of the major requirements of template synthesis for the capsule preparation [12- 13].

Monolayer is impartment for the polystyrene nanoparticles which make multilayer to the separate beads for many applications such as industrial, agriculture.

The researchers are working for many techniques to preparation polystyrene monolayer. Many techniques used for separate polystyrene multilayer to monolayer are more important for may researches as well as researchers to obtain many different techniques for preparation monolayers to get best result used for science and even for polymer technology ,medicine , pharmacy and agriculture, made to easy separate medicine to human body and manure to the plant [14- 15].

In the case of polymer technology, it is made the best properties and characterization and mechanical properties for polymer technology.

Experimental Work

Materials

Materials	Description (Purity)	Company Supplier
Styrene (C_6H_8)	99%	Aladdin, Shanghai, China
alumina Oxide, Natural (Al_2O_3)	75 %	Aldrich Chemical Co., USA
Potassium persulfate (KPS)	99.5 %	Aldrich Chemical Co. USA
Sodium dodeyl Sulfate (SDS)	---	Sigma –Aldrich U.S.A.
Ethanol	99.7 %	Sinopharm Chemical Reagent Co. Ltd. China

The above chemicals were used as soon as they were received; deionized water was used for the experiment.

Prewashed Styrene

Firstly, in a Pasteur pipette, a small piece of cotton was placed inside the pipette very carefully as a block and was gently put until it cannot be removed further down the pipette and the pipette was filled half of alumina (Al_2O_3) Natural and monomer ,styrene pass through it. Styrene was collected from the pipette into a clean graduated cylinder, and then the styrene was kept in a refrigerator before use.

Synthesis of Polystyrene nanoparticles:

Polystyrene nanoparticles were synthesized by soap-free emulsion polymerization in a three-necked flask equipped with a reflux condenser and a mechanical stirrer. A typical synthesis of polystyrene nanoparticles was as follows:

A 0.05 gm sodium dodecyl sulfate (SDS) was dissolved in 45 mL deionized water with magnetic stirrer at 30 °C overnight. It was degassed for 30 minutes under N_2 gas. Then 12 mL of prewashed monomer (Styrene) was added and stirred at 290 rpm under N_2 gas for 30 minutes with magnetic stirrer , and the mixture was refluxed , and heated up to 80 °C. After 10 minutes, when the temperature reached to 80 °C, and then 0.12 g potassium persulfate, powder dissolved in 5mL deionized at 30 °C for 30 minutes was added to the mixture. Temperature of the reaction was kept at 80 °C, and then reaction was stopped after 8 hours. After cooling the mixture it was centrifuged at 10.000 rpm for 35 minutes to precipitate the Polystyrene beads. The separated Polystyrene nanoparticles were washed three times with deionized water and pure ethanol with recycle ultrasonic and centrifugation .The Polystyrene nanoparticles were dried in vacuum oven at 60 °C for 24 hours.

Fabrication of Polystyrene Monolayers

In this technique preparing Polystyrene Monolayer

A 0.05g Polystyrene beads were dissolved in 10mL of water or ethanol than sonication for 30 min. After Polystyrene Monolayer was transferred onto a piece of Si wafer, washed with water or ethanol and dried in Air at room temperature for 24h. Then, the polystyrene monolayer can be obtained.

SEM Image (Test)

The resulting particles morphologies were observed by SEM which was carried out on a Sirion 200 SEM at an accelerating voltage of 10 kV. To prepare samples for SEM, a drop of the dialyzed particles dispersion was dropped

on a clean silicon wafer, and it was followed by triple rinsing in ethanol with ultrasonic cleaning for 30 min then nitrogen (N_2) gas was allowed to evaporate. Then, the samples were coated with a thin layer of gold.

TEM Tests

Investigation was performed on a FEI Tecnai G2 20 TEM microscope operated at an acceleration voltage of 200 kV. For TEM samples preparation, a drop of the very dilute dispersion was placed onto TEM copper grid pre-coated with carbon thin film. The samples were allowed to dry in an atmosphere and at room temperature for 1 day before observation.

Result and Discussion

The SEM images (1-4) of polystyrene nanoparticles showed beads structure as clear in those images uniform structure and distribution. The SEM images (5-6) of polystyrene monolayers images showed a very clear polystyrene monolayers structure. The TEM images (7-10) of polystyrene nanoparticles showed beads structure and best distribution.

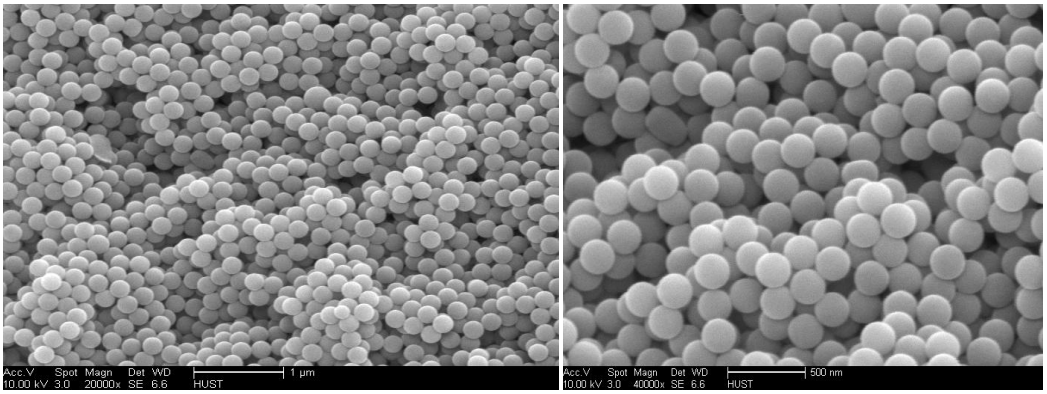

Photo 1: Polystyrene nanoparticles

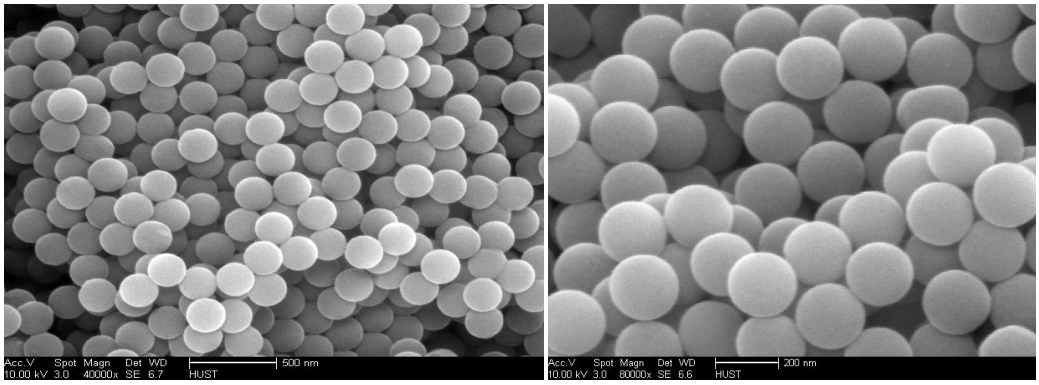

Photo 2: Polystyrene nanoparticles

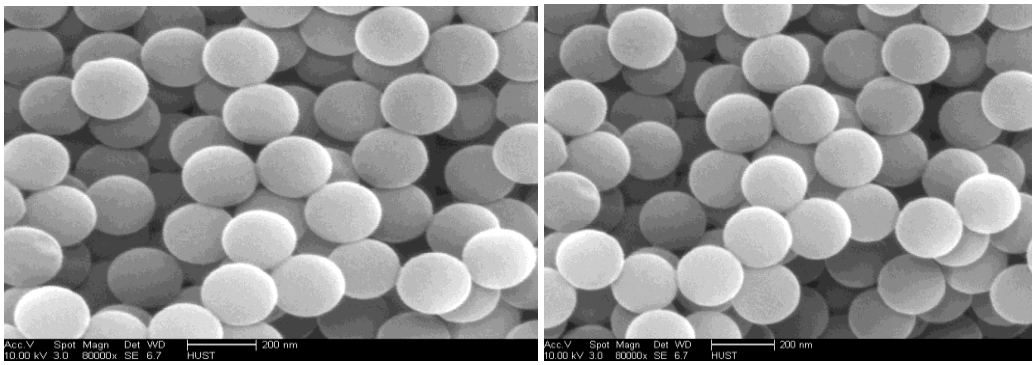

Photo 3: Polystyrene nanoparticles

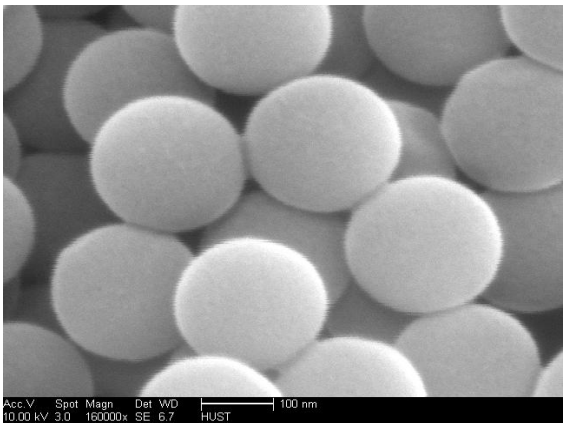

Photo 4: Polystyrene beads nanoparticles

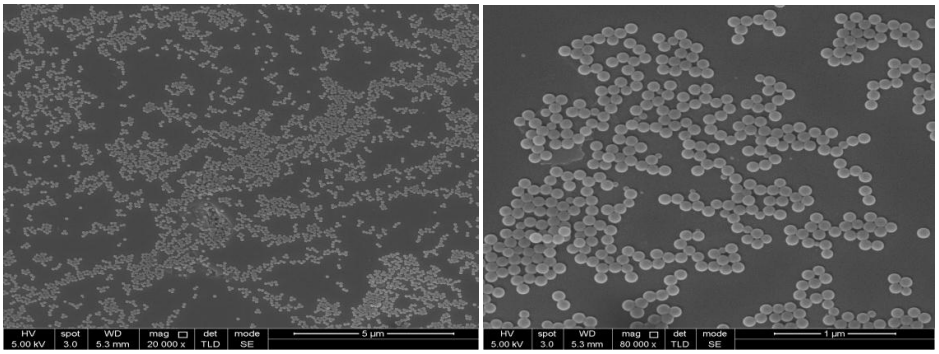

Photo 5: Polystyrene monolayers

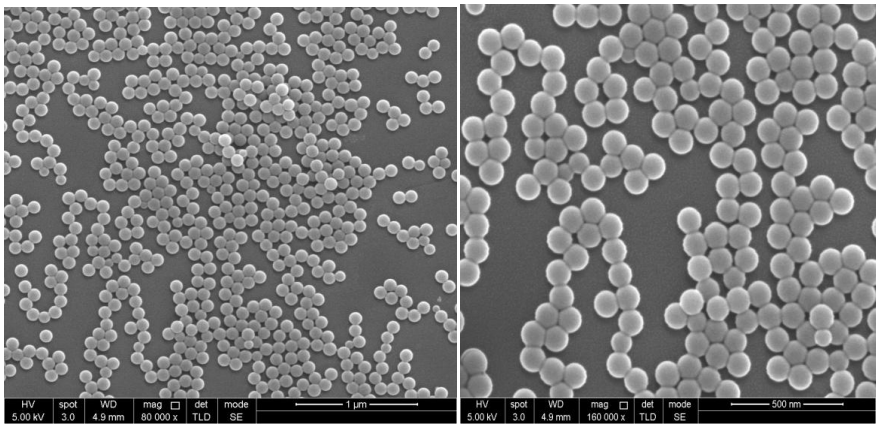

Photo 6: Polystyrene monolayers

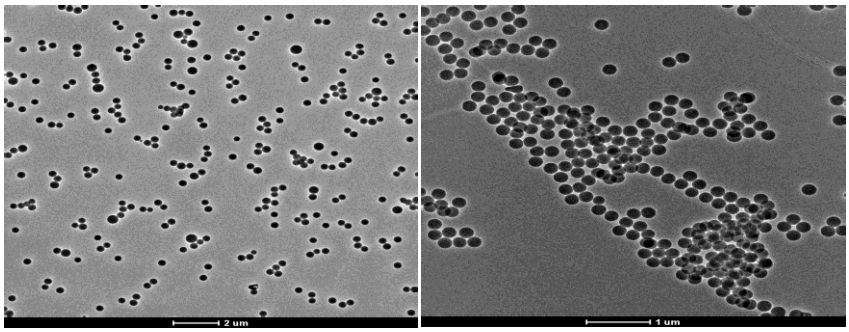

Photo 7: TEM polystyrene beads nanoparticles in H_2O

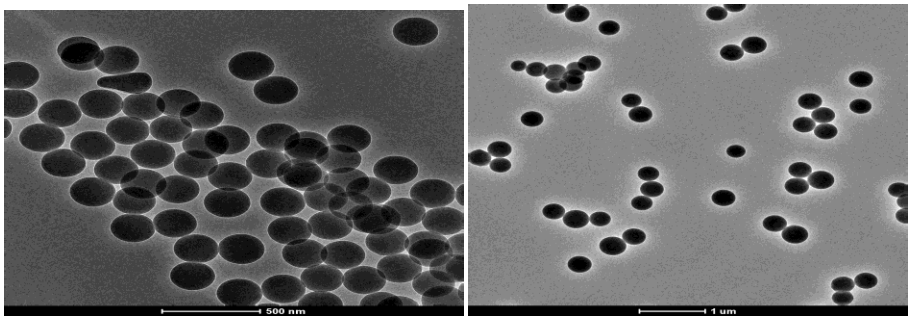

Photo 8: TEM polystyrene beads nanoparticles in H_2O

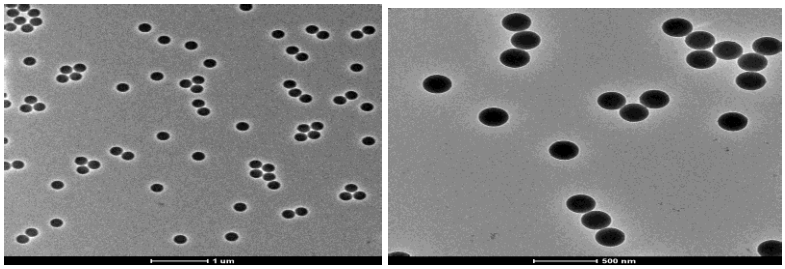

Photo 9: TEM polystyrene beads nanoparticles in H_2O

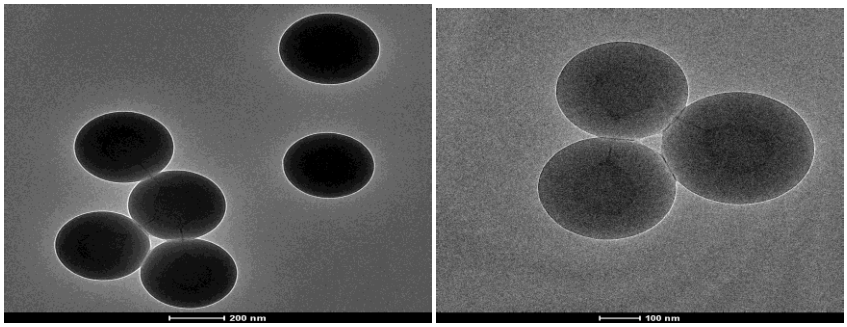

Photo 10: TEM polystyrene beads nanoparticles in H_2O

Conclusions

In conclusion, I modified the synthesis polystyrene nanoparticles**.** The reaction was intendance under (N_2) gas at 80 °C temperature for 8 hours by using method of soap-free emulsion polymerization. The results shown here is suitable for industrial production. The polystyrene nanoparticles and polystyrene monolayers fabrication have shown the best enhancement results.

Acknowledgements

This work was supported by UNESCO, People's Republic of China (Great wall), and Al-Baida'a University, Republic of Yemen.

References

1. Abdullah Mohammed Ali Altaweel, Nabil Abdullah Noman Alkadasi , and Prof .Jin Tao Zhu " Synthesis of Highly Crosslinked PMMA Nanoparticles and Their Application in Membrane and Opal Film " Journal of Andalus University for Applied sciences No. 5 ,Volume (10) July 2015.
2. Synthesis and characteristics of Polystyrene nanoparticles and Polystyrene Membrane, Al-Qadisiya Journal for Engineering Science (Accepted).
3. Shin-Hyun Kim, Seog-Jin Jeon, Gi-Ra Yi, Chul-Joon Heo, Jae Hoon Choi, and Seung-Man Yang ," Optofluidic Assembly of Colloidal Photonic Crystals with Controlled Sizes, Shapes, and Structures"Adv.

Mater., 20, 1649–1655 (2008).

4. Yusuke Tsuda, Manami Kojima, Takaaki Matsuda, And Jae Min Oh , Soluble Polyimides Based on Long-chain Alkyl Groups via Amide Linkages , Polymer Journal, Vol. 40, No. 4, 354–366 (2008).
5. Zhong-Ze Gu, Hiroshi Uetsuka, Kazuyuki Takahashi, Rie Nakajima, Hiroshi Onishi, Akira Fujishima, and Osamu Sato "Structural Color and the Lotus Effect" , Angew. Chem. Int. Ed. 42, No. 8, 894-897(2003).
6. M. Yoldi, W. Gonza Lez–Vin As, M. C. Arcos, R. Sirera, Electrophoretic deposition of colloidal crystals assisted by hydrodynamic flows ",J Mater Sci 41 2965–2969 (2006).
7. Zhiqiang Sun, Bai Yang, Fabricating colloidal crystals and construction of ordered nanostructures, Nanoscale Res Lett 1:46–56 (2006).
8. Justin J. Bohn, Matti Ben-Moshe, Alexander Tikhonov, Dan Qu, Daniel N. Lamont, Sanford A. Asher, Charge stabilized crystalline colloidal arrays as templates for fabrication of non-close-packed inverted photonic crystals", Journal of Colloid and Interface Science 344 298–307 (2010).
9. Hamid Javaherian Naghash, Rouhollah Akhtarian, and Mohammad Iravani, Synthesis and properties of polyvinyl acetate emulsion copolymers by three novel non-ionic functional polyurethane surfactants", Korean J. Chem. Eng., 31(7), 1281-1287 (2014).
10. Jung-Min Lee, Shin-Jae Kang, Soo-Jin Park, Synthesis of Polyacrylonitrile Based Nanoparticles via Aqueous Dispersion Polymerization", Macromolecular Research, 17, No. 10, 817-820 (2009).
11. Yeonhwa Wi, Kangseok Lee, Byung Hyung Lee, Soonja Choe, Soap-free emulsion polymerization of styrene using poly(methacrylic acid) macro-RAFT agent", Polymer, 49, 5626–5635 (2008).
12. Pavan S. Chinthamanipeta, Shuji Kobukata, Hiromichi Nakata, Devon A. Shipp," Synthesis of poly(methyl methacrylate)–silica nanocomposites using methacrylate-functionalized silica nanoparticles and RAFT polymerization" Polymer ,49, 5636–5642 (2008).
13. Kei Sanada, Rahul Patil, Yousuke Ooyama, Jun Yano, and Yutaka Harima," Template-free Formation of Microspheres Based on Poly(*N*-methylaniline), Polymer Journal, 38, No. 7, 732–736 (2006).
14. Zhong-Ze Gu, Haihua Chen, Shuai Zhang, Liguo Sun, Zhuoying Xie, Yangyang Ge , Rapid synthesis of monodisperse polymer spheres for self-assembled photonic crystals ",Colloids and Surfaces A: Physicochem. Eng. Aspects 302 312–319, (2007) .
15. Yizhi W, Cheng Z, Ye Y, Ziwen W, Weijia S, Huijie W and Xiaoliang X. Fabrication of wafer – Zize Monolayer close –packed colloidal crystals via slope self –assembly and thermal treatment. Langmuir; 29:14017-14023, 2013.