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Comparative studies on the different synthesis of polystyrene spheres in aqueous water and alcohol systems to obtained polystyrene monolayers

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Abstract
In this paper, comparative studies on the different synthesis of polystyrene spheres in aqueous water and alcohol systems were successfully developed by emulsion soap polymerization then polystyrene monolayer was obtained. Polystyrene spheres in aqueous water and alcohol systems were carried out at 80 ^{0}C temperature. Polystyrene spheres synthesis in aqueous water was given best result when comparative with alcohol soluble.
The result of enhancement of the structure, properties and characterization, and its application was found in polystyrene monolayer and drug industrial**.**
The characterization of polystyrene spheres and monolayer were done by SEM, TEM and XRD.

Keywords: polystyrene spheres, polystyrene monolayer, properties and characterization

Introduction
In the previous work, Synthesis and characteristics of Polystyrene nanoparticles and Polystyrene membrane were synthesized [1].
Monodispersed polystyrene spheres have already found a broad range of many applications in fields such as drug delivery, medicine and drug industry. The ability to assemble these polystyrene spheres into crystalline arrays allows one to obtain interesting and useful functionalities not only from the application of constituent materials but also from the fundamental physics of systems with the long-range, mesoscopic order that characterizes periodic structures [2–4]. For example, two-dimensional hexagonal lattices of polystyrene spheres have been successfully demonstrated as ordered arrays of optical microlenses in image processing [5-6]; as physical masks for evaporation or reactive ion etching to fabricate regular arrays of micro- or nanostructures, and as patterned arrays of relief structures to cast elastomeric stamps for use in soft lithographic techniques [7-8].
All these applications depend strongly on the availability of polystyrene spheres with tightly controlled sizes and high monodispersity.
The major components of emulsion polymerization of polystyrene include a monomer (styrene), a dispersion medium (in most cases, water or alcohol), an emulsifier (surfac-tant), and an initiator (usually water-soluble or alcohol).
In this method, Comparative studies on the synthesis of polystyrene spheres were done in aqueous water and alcohol systems and obtained polystyrene monolayers. Synthesis of polystyrene spheres 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 or alcohol.
Different polymerization of the encapsulated monomer leads to the formation of monodispersed latex spheres. In this paper, i investigated systematically the synthesis of synthesis of polystyrene spheres in aqueous water or alcohol system, dispersion medium. The size of polystyrene spheres can be controlled in aqueous water or alcohol dispersion medium. In addition, a seeded growth technique based on aqueous water or alcohol dispersion media was developed to increase the size of Polystyrene spheres and improve spheric-shape. In comparison to the two-step seed growth technique [9], the growth period of our seeded technique is much reduced due to excluding of swelling process of styrene in seed.
Common issues associated with polystyrene spheres synthesis are poly dispersity and meso porous orientation [10-12]. polystyrene spheres 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 [13- 14].
Monolayer is impartment for the polystyrene sphere which make multilayer to the separate beads for many application such as industrial, agriculture.
The researches 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 [15-18].
In the case of polymer technology, it is made the best properties and characterization and mechanical properties for polymer technology.

Experiment

Materials

Styrene (C_6H_8) was received from Aladdin, shanghai and washed with alumina Oxide, natural (Al_2O_3) to remove the inhibitor. Methacylic acid (MAA) ($C_4H_6O_2$), azodiisobutyronitrile (AIBN) $C_8H_{12}N_4$, polyvinylpyrrolidone (PVP K-30, Mw = 40 000 g mol), These chemicals were used. Distilled water was used for the experiment.
The Characteristics of Styrene, Methacylic acid, Poly vinyl Pyrrolidone, of 2, 2 -A 30 bis-Iso butyronitrile, Aluminum oxide, neutral, and Ethanol mention in given table 1, 2, 3, 4, 5 and 6 respectively.

Table 1: General characteristics of styrene

Molecular formula	**Styrene ($C_{28}H_8$) ≥ 99 %**
Appearance	liquid
Molecular weight	104.15
Company	Sinopharm chemical reagent Co, Ltd, China

Table 2: General characteristics of methacylic acid (MAA) ($C_4H_6O_2$) 98%

Molecular formula	**Methacylic acid (MAA)($C_4H_6O_2$) 98%**
Appearance	Liquid
Molecular weight	86.09
Company	Sinopharm chemical reagent Co, Ltd, China

Table 3: General characteristics of poly vinyl pyrrolidone (PVP) C_6H_9 $ON)_n$

Molecular formula	**Poly vinyl Pyrrolidone (PVP) C_6H_9 $ON)_n$**
Appearance	White powder
Molecular weight	40.000
Company	Libia, Chinghai, China

Table 4: General Characteristics of 2, 2 –A 30 bis –Iso butyronitrile

Molecular formula	**2,2 –A 30 bis –Iso butyronitrile $(CH_3)_2(CN)CN=NC(CN)(CH_3)_2$**
Appearance	Powder
Molecular weight	164.20768 g/mol
Concentration	25 – 28 %
Company	Shi Si hevei, Chinghai, China

Table 5: General characteristics of aluminum oxide, neutral ≥ 75 %

Molecular formula	**Aluminum oxide, neutral ≥ 75 % AL_2O_3**
Appearance	White Powder
Ph.	6.5- 7.5
Molecular weight	101.96
Company	Sinopharm chemical reagent Co, Ltd, China

Table 6: General characteristics of Ethanol (C_2H_6O).

Molecular formula	**Ethanol (C_2H_6O) ≥ 99.7%**
Appearance	liquid
Density 20 ^{0}C (g/ml)	0.789 – 0.791
Molecular weight	46.07
Company	Sinopharm chemical reagent Co, Ltd, China

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, then the styrene was kept in a refrigerator before use.

Preparation of polystyrene seed beads by dispersion polymerization.

Polystyrene seed beads were prepared by dispersion polymerization in a 100 mL three-necked round-bottom glass reactor equipped with a nitrogen inlet, a thermometer and a mechanical rabble. PVP K-30 (0.375 g) dissolved in 50 mL of (ethanol or water solvents) was placed into the reactor. After nitrogen purging, the reactor was immersed in an oil bath equipped with a thermostat set at 80 ^{0}C for 5 min. Then, AIBN (0.125 g) dissolved in a mixture of styrene (14.5 g), and MAA (0.127 g) was added to the reactor. The polymerization was conducted for 8 hrs at a stirring rate of 180 rpm. After cooling down to room temperature, the resulting beads were washed by centrifugation/redispersion cycles with ethanol and distilled water three times each to remove by-products. Finally, the beads were dried in a vacuum oven for 24 h. Then SEM, TEM and XRD was done for characterization.

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.

Scanning electron microscopy

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.

Transmission Electron Microscope (TEM) Test

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.

XRD Results

For XRD results, a small amount of powder the sample was put in the XRD machine connected with computer. The result was record between intensity (KCPS) and Degree (2ɵ) shown in the figures (1).

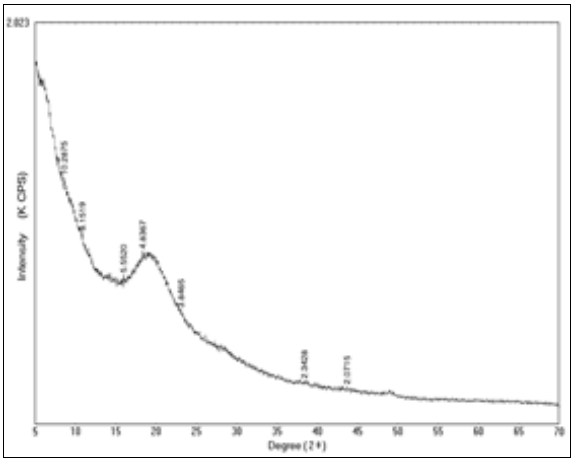

Fig 1: XRD PS+PVP in H_2O soluble

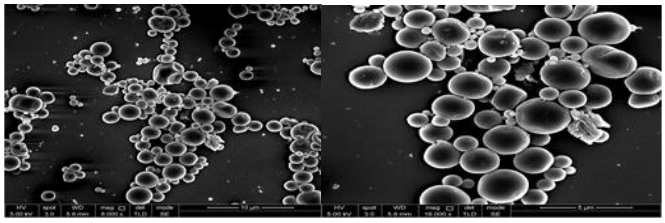

Fig 2: PS+PVP in ethanol soluble

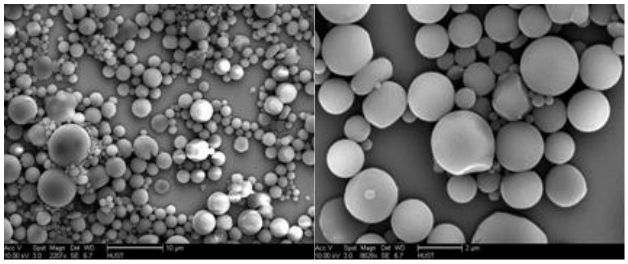

Fig 3: PS+PVP in ethanol soluble

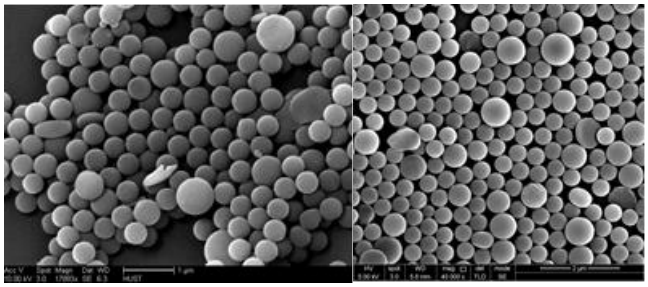

Fig 4: PS+PVP in H_2O soluble

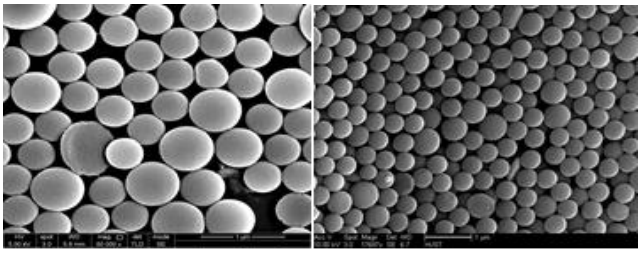

Fig 5: PS+PVP H_2O soluble

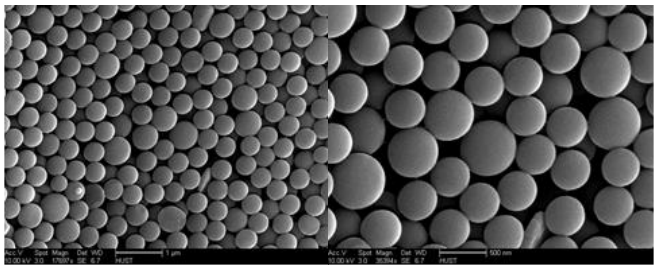

Fig 6: PS+PVP H_2O soluble

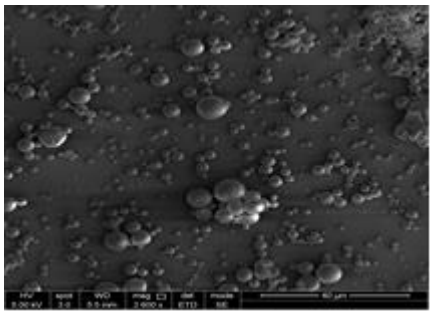

Fig 7: Monolayer PS+PVP in Ethanol soluble

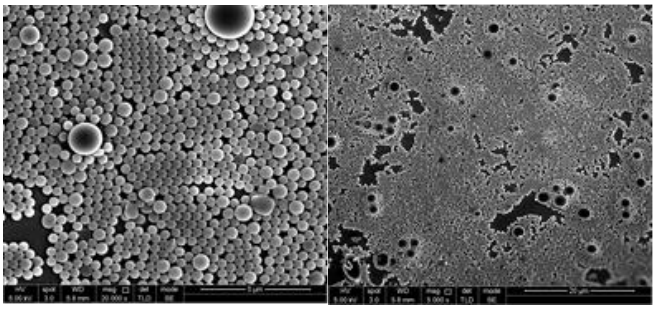

Fig 8: Monolayer PS+PVP in H_2O soluble

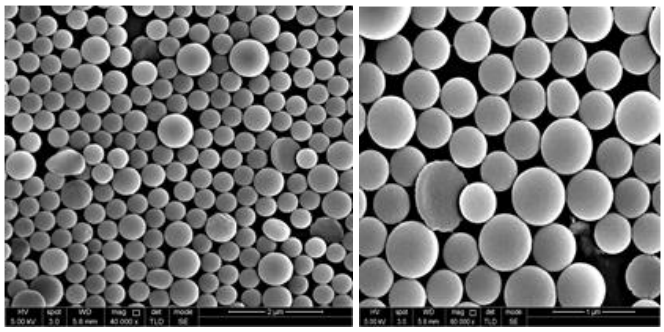

Fig 9: Monolayer PS+PVP in H_2O soluble

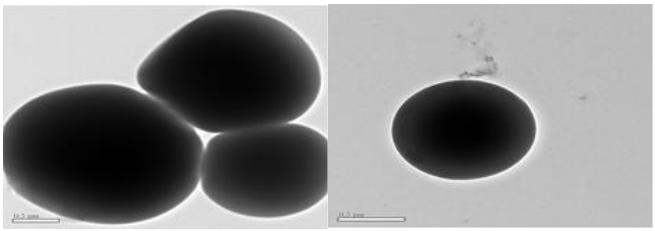

Fig 10: TEM PS +PVP in Ethanol soluble

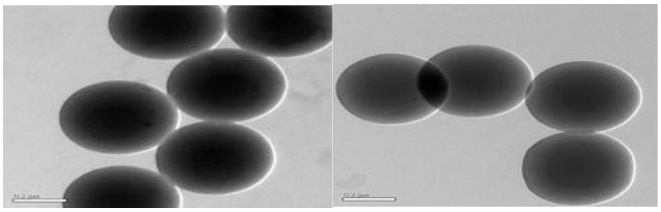

Fig 11: TEM PS +PVP in H_2O soluble

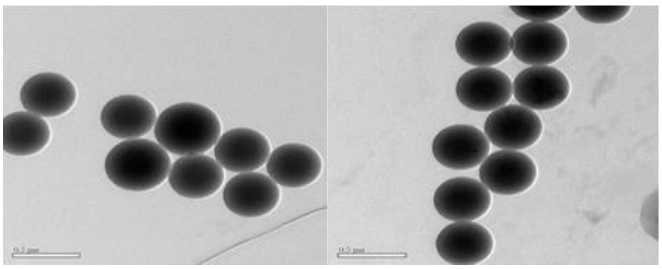

Fig 12: TEM PS +PVP in H_2O soluble

Result and Discussion

The SEM images (1-2) of polystyrene spheres in ethanol soluble showed beads structure as clear in those images.

In the SEM, images (3-5) of polystyrene spheres in water soluble showed inform beads structure and smooth, while the SEM images (6-8) of monolayer polystyrene spheres showed best uniform structure and smooth and best distribution. The TEM images (9) of polystyrene spheres in alcohol soluble showed beads structure and distribution, while the TEM images (10-11) of polystyrene spheres in water soluble showed beads structure, distribution.

Conclusions

In conclusion, I synthesized polystyrene spheres and polystyrene monolayer. The reaction was carried out under (N_2) gas at 80 ^{0}C temperature for 8 hrs by using method of soap-free emulsion polymerization to prepare polystyrene spheres then get polystyrene monolayers.

The best result shows from SEM and TEM polystyrene spheres and polystyrene monolayer in case of water system.

Acknowledgements

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References

1. Synthesis and characteristics of Polystyrene nanoparticles and Polystyrene Membrane, Al-Qadisiya Journal for Engineering Science (Accepted).
2. 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, 2015; 5(10).
3. Nabil Abdullah Noman Alkadasi, Synthesis and Characterization of Super paramagnetic (Fe_3O_4) Magnetite Nanoparticles Coated with Oleic Acid, Chemistry Research Journal. 2016, 1(1):1-7.
4. Shin-Hyun Kim, Seog-Jin Jeon, Gi-Ra Yi, Chul-Joon Heo, Jae Hoon Choi, Seung-Man Yang, *et al*. Optofluidic Assembly of Colloidal Photonic Crystals with Controlled Sizes, Shapes, and Structures Adv. Mater., 2008; 20:1649-1655.
5. Yusuke Tsuda, Manami Kojima, Takaaki Matsuda, Jae Min Oh. Soluble Polyimides Based on Long-chain Alkyl Groups via Amide Linkages, Polymer Journal, 2008; 40(4):354-366.
6. Zhong-Ze Gu, Hiroshi Uetsuka, Kazuyuki Takahashi, Rie Nakajima, Hiroshi Onishi, Akira Fujishima. Structural Color and the Lotus Effect, Angew. Chem. Int. Ed. 2003; 42(8):894-897.
7. Yoldi M, Gonza Lez-Vin as W, Arcos MC, Sirera R. Electrophoretic deposition of colloidal crystals assisted by hydrodynamic flows, J Mater Sci. 2006; 41:2965-2969.
8. Zhiqiang Sun, Bai Yang, Fabricating colloidal crystals and construction of ordered nanostructures, Nanoscale Res Lett., 2006; 1:46-56.
9. Justin J Bohn, Matti Ben-Moshe, Alexander Tikhonov, Dan Qu, Daniel Lamont N, 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, 2010; 344:298-307.
10. Niranjan Yeole, Dilip Hundiwale, Tushar Jana. Synthesis of core-shell polystyrene nanoparticles by surfactant free emulsion polymerization using macro-RAFT agent, Journal of Colloid and Interface Science. 2011; 354:506-510.
11. Hamid Javaherian Naghash, Rouhollah Akhtarian, Mohammad Iravani, Synthsis and properties of polyvinyl acetate emulsion copolymers by three novel non-ionic functional polyurethane surfactants, Korean J Chem. Eng. 2014; 31(7):1281-1287.
12. Jung-Min Lee, Shin-Jae Kang, Soo-Jin Park, Synthesis of Polyacrylonitrile Based Nanoparticles via Aqueous Dispersion Polymerization, Macromolecular Research, 2009; 17(10):817-820.
13. Nabil Abdullah Noman Alkadasi. Synthesis of Silica Nanoparticles Coat with Gold nanoparticles and its Application, Chemistry Research Journal. 2016; 1(2):26-23.
14. Yeonhwa Wi, Kangseok Lee, Byung Hyung Lee, Soonja Choe. Soap-free emulsion polymerization of styrene using poly (methacrylic acid) macro-RAFT agent, Polymer, 2008; 49:5626-5635.
15. Pavan Chinthamanipeta S, Shuji Kobukata, Hiromichi Nakata, Devon Shipp A. Synthesis of poly(methyl methacrylate)-silica nanocomposites using methacrylate-functionalized silica nanoparticles and RAFT polymerization Polymer, 2008; 49:5636-5642.
16. Kei Sanada, Rahul Patil, Yousuke Ooyama, Jun Yano, Yutaka Harima. Template-free Formation of Microspheres Based on Poly (*N*-methylaniline), Polymer Journal. 2006; 38(7):732-736.
17. Zhong-Ze Gu, Haihua Chen, Shuai Zhang, Liguo Sun, Zhuoying Xie, Yangyang Ge, *et al*. Rapid synthesis of monodisperse polymer spheres for self-assembled photonic crystals, Colloids and Surfaces A: Physicochem. Eng. Aspects, 2007; 302:312-319.

18. Yizhi W, Cheng Z, Ye Y, Ziwen W, Weijia S, Huijie W, *et al*. Fabrication of wafer - Zize Monolayer close - packed colloidal crystals via slope self - assembly and thermal treatment. Langmuir. 2013; 29:14017-14023.