

Preparation of Covalent and Solvent-resistance Colored Latex Particles and Its Application on Cotton Fabric

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Abstract: Conventional colored latex particles have poor solvent resistance due to the absence of chemical bonds between the dye and polymer component, resulting in staining and greatly restricting its application. In this research, the disperse dye was chemically bonded to the polymer to prepare covalent and solvent-resistance colored latex particles. Firstly, C.I. Disperse Red 60, as a common disperse dye in industry, was modified by acryloyl chloride (amidation reaction) for the purpose of introducing the C=C bonds. The structure of modified C.I. Disperse Red 60 was confirmed by ¹HNMR, FTIR and elemental analysis and its spectral property was also evaluated. Then the covalent colored latex particles were synthesized via mini-emulsion copolymerization of styrene (St) and ethyl acrylate (EA) in presence of modified C.I. Disperse Red 60 monomer. Results of FTIR, TG, DSC and TEM indicated that the covalent colored latex particles were successfully prepared. By using UV-spectroscopy, the solvent resistance of the colored latex membranes in petroleum ether, hexane, cyclohexane, and ethanol was monitored, respectively. Slight change of the absorption was detected for 10 days, which verified the excellent solvent resistance of covalent colored latex membranes. Finally, the prepared colored latex particles were applied on cotton printing in the absence of binder. The results showed that the colored latex particles printed fabric had superior rubbing fastness and soft hand feel.

Keywords: Modified C.I. Disperse Red 60, Covalent colored latex particles, Solvent resistance, Cotton printing

Introduction

Generally, traditional colored latex particles [1-5] can be prepared by encapsulating some colorant in polymer shell [6,7] or mixing colorless latex with colorant [8,9]. Colored latex particles with various ingredients and different diameters have attracted much attention in recent years [10-12]. Due to large specific surface area and visible color function, colored latex particles have a wide variety of traditional application, such as ink [13,14], coating [15,16] and textile dyeing [17]. Although colored latex particles have some excellent properties, there are some potential defects that have restricted its application. For example, when the colored latex particles are in contact with the organic solvents, the dye dissolves in the organic phase due to the weak interacting force between the colorants and the polymer compositions.

Compared with traditional colored latex particles prepared by encapsulation and mixing, the method of obtaining covalent colored latex particles [2,18] by chemical bonds between the colorants and different polymer compositions can efficiently settle the above problem. For example, Jin [19] fabricated covalent colored PU latexes with pendent chromophores on the PU backbone. By the covalent incorporation of chromophores with PU matrix, the covalent colored PU latex films showed superior light fastness

compared with the corresponding non-covalent colored PU latex films. Furthermore, Li [20] fabricated a kind of covalent colored polymer latex with a much better light fastness than that of the noncovalent colored polymer latexes. Despite the significant achievements, there are few research reports on the preparation of colored latex particles with excellent solvent resistance.

To solve the above problem, the solvent resistant colored latexes particles were prepared as an attempt to extend their applicability. Disperse dyes with excellent color strength have become one of the most important colorants for preparing colored latex particles. Importantly, the disperse dyes have massive hydroxyl and amino groups, which can easily be copolymerized with other monomers to prepare covalent colored latex particles after modification. In this paper, C.I. Disperse Red 60 was modified by acryloyl chloride to obtain the modified C.I. Disperse Red 60 with C=C bonds. And then, the modified C.I. Disperse Red 60 was polymerized with styrene (St) and ethyl acrylate (EA) via mini-emulsion polymerization to obtain covalent colored latex particles. Chemical structure of covalent colored latex particles was characterized. Centrifugal and thermal stability, solvent resistance of covalent colored latex particles was also investigated. Finally, the prepared colored latex particles were used for printing of cotton fabric, and the rubbing fastness and hand feel of printed fabric were investigated.

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Experimental

Materials

Cotton fabric (140 g/m²) was purchased from Xinfeng Printing and Dyeing Co., Ltd. (Huzhou, China). C.I. Disperse Red 60 was provided by the J&K Scientific Co., Ltd. (Shanghai, China). Acryloyl chloride, hexadecane (HD), styrene (St), ethyl acrylate (EA), ammonium persulfate (APS) were obtained from Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China). Allyloxy nonyl alcohol polyoxyethylene ether sulfate (DNS-86) was purchased from Qingxin Haner Chemical Technology Co., Ltd. (Guangdong, China). Ammonium polyacrylate thickener (DM-5221) and polyacrylate binder (DM-5128) were purchased from DYMATIC Chemicals Co., Ltd. (Shanghai, China). Distilled water was used for the experiments.

Modification of C.I. Disperse Red 60

C.I. Disperse Red 60 (8.28 g, 25 mmol) and triethylamine (2.54 g, 24 mmol) were dissolved in dichloromethane (30 mL) and transferred into a three-necked flask in an ice bath. Acryloyl chloride (3.62 g, 40 mmol) was dissolved into dichloromethane (10 mL), and the solution was slowly added into the above system within 2 h. The end point of the reaction was monitored by thin-layer chromatography (TLC) using a mixture of ethyl acetate/petroleum ether (1:8, v/v) as the mobile phase. After removal of the residual developing solvents, the modified C.I. Disperse Red 60 was prepared.

Melting point of the product is 117.9–119.4 °C and yield is 46.7%. FT-IR (KBr, cm⁻¹, Figure 1a): 2925, 2846 (-CH₂-), 1644 (-C=C-), 3469, 3250 (-NH₂), 3433 (-OH). Elemental analyses: Calc.: C 71.69, H 3.89, N 3.63, Found: C 71.33, H 3.58, N 3.55. ¹H-NMR (400MHz, DMSO-d₆, TMS, δ/ppm, Figure 1b): 8.24–8.20 (d, 1H), 8.07–8.03 (d, 1H), 7.91–7.81 (m, 2H), 7.54–7.49 (m, 2H), 7.33–7.29 (m, 1H), 7.26–7.23 (d,

Table 1. Recipe for preparing O/W emulsion and colored latex particles

O/W emulsion		Colored latex particles	
Composition	Content (g)	Composition	Content (g)
Modified C.I. Red 60	0.23	O/W emulsion	40.78
St (monomer)	7.50	APS (initiator)	0.23 g
EA (monomer)	7.50		
HD (co-emulsifier)	0.15		
DNS-86 (emulsifier)	0.40		
Water	25.00		

1H), 6.67–6.34 (s, 1H), 6.51–6.35 (m, 2H), 6.14–6.10 (m, 1H).

Preparation of O/W Emulsion

Modified C.I. Disperse Red 60 was dissolved in a mixture of St, EA and HD to obtain the oil phase. An aqueous phase was prepared by DNS-86 solution under mechanical stirring (RW20N, IKA) at 12000 rpm for 15 min. Then, the oil phase was slowly added into the water phase and emulsified for another 45 min to obtain O/W emulsion. The specific recipe is shown in Table 1.

Preparation of Colored Latex Particles

The O/W emulsion was transferred to four-neck flask equipment with a stirrer. The flask was thoroughly charged with N₂ for 20 min, and the temperature was raised to 75 °C. Meanwhile, the initiator APS dissolved in 5 mL of water was added into the flask and maintained for 5 h. The specific recipe is given in Table 1. The dispersion was cooled to room temperature and centrifuged at 10000 rpm for 1 h. The sediment was washed three times with ethanol and followed by three times with water to remove the unreacted reagents. Finally, the sediment was freeze-dried to obtain the colored latex particles.

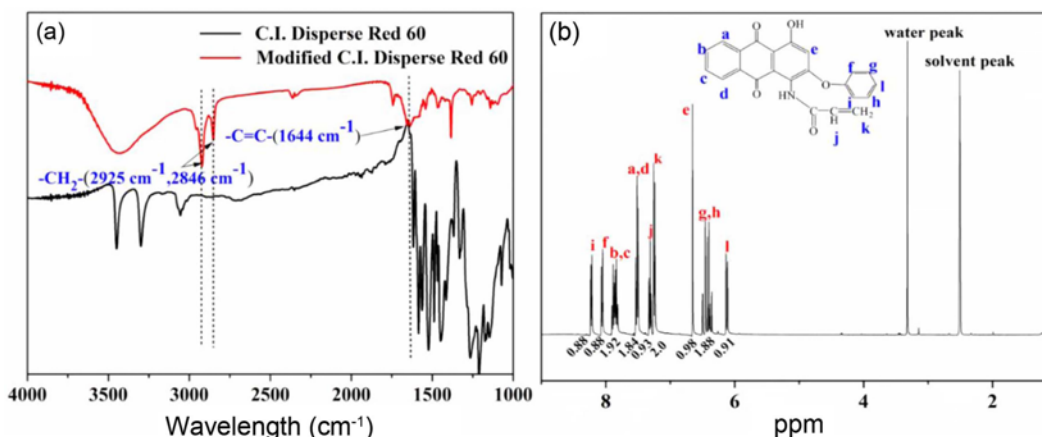


Figure 1. (a) FT-IR spectra of modified C.I. Disperse Red 60 and C.I. Disperse Red 60 and (b) ¹H-NMR spectrum of modified C.I. Disperse Red 60.

Table 2. Recipe for printing paste

Components	Conventional printing paste	Colored latex particles printing paste
C.I. Red 60 dispersion (g)	30.25	-
Colored latex particles dispersion (g)	-	30.25
DM-5221 (g)	2.5	2.5
DM-5128 (g)	10	-
Water (g)	7.25	17.25

Preparation of Colored Latex Membranes

Colored latex particles (20 g) were dispersed in distilled water (100 g) under ultrasonic waves for 5 min to get the colored latex particles dispersion. The above dispersion was cast onto a clean PTFE template, and was dried in an oven at 60 °C for 12 h.

Printing

Colored latex particles (0.25 g), distilled water (30 g) were mixed and treated with ultrasonic waves for 5 min to get the colored latex particles dispersion. A screen printing technique was employed to print the cotton fabric under a without binder condition. The printing pastes were prepared according to the recipe in Table 2. The printed cotton fabric was obtained by curing at 150 °C for 3 min.

C.I. Disperse Red 60 (0.25 g), distilled water (30 g) were mixed and treated with ultrasonic waves for 5 min to form the C.I. Disperse Red 60 dispersion. The cotton fabric was screen-printed. The printing pastes were prepared also according to the recipe in Table 2. The conventional printed cotton fabric was obtained by curing at 150 °C for 3 min.

UV-vis Spectra

C.I. Disperse Red 60 and modified C.I. Disperse Red 60 were dissolved in dichloromethane (DLM), tetrahydrofuran (THF), N, N-dimethylformamide (DMF), respectively. All the concentrations were adjusted to the 1×10^{-5} mol/L. The UV-vis absorption spectra were recorded with a UV-vis spectroscopy (UV-2450, Shimadzu, Japan).

¹H Nuclear Magnetic Resonance (¹H-NMR)

The structure of modified C.I. Disperse Red 60 was characterized by 400 MHz digital spectrometer (AVANCE III, Bruker AXS GmbH, Germany) using DMSO-d₆ as a solvent and TMS as the internal standard.

Fourier Transform Infrared Spectroscopy (FT-IR)

FT-IR spectra of modified C.I. Disperse Red 60, C.I. Disperse Red 60, colored latex particles and P(St-co-EA) in KBr pellets were obtained with a spectrometer (NICOLETS10, Nicolet Instrument Corporation, USA). An approximately 2 mg sample was mixed with 200 mg KBr (spectroscopic

grade), and FT-IR spectra were recorded in the range of 4000-1000 cm⁻¹ at a resolution of 4 cm⁻¹ with 32 scans per sample.

Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM)

C.I. Disperse Red 60 and colored latex particles were ultrasonically dispersed in deionized water and diluted to 1000 times. One drop of the above dilution was placed on a 400-mesh carbon-coated copper grid and dried in air. Transmission electron microscope (H-7000, Hitachi, Japan) was used to observe the further information about morphology at 200 kV. The surface morphology of colored latex particles printed fabric and conventional printed fabric were observed by scanning electron microscope (SU1510, Hitachi, Japan) at an accelerating voltage 5.0 kV. The free surfaces were coated with thin layers of gold before observation.

Thermal Properties

Differential scanning calorimetry (DSC) was performed under nitrogen conditions using differential scanning calorimeter (TQ-200, TA Instruments, USA) with a ramp between -60 and 200 °C. Thermogravimetric analysis (TGA) was performed under nitrogen conditions using a TG apparatus (TGA/SDTA851e, Mettler Toledo Instrument Co., LTD, Switzerland) with a 10 °C/min ramp between 20 and 600 °C.

Particle Size

The particle size of colored latex particles was measured by dynamic light scattering (DLS) with Malvern Particle Size Analyzer (Nano-ZS90, Malvern Instruments Co., Ltd., England) at 25 °C when it was diluted to 1000 times with distilled water.

Stability of the Colored Latex Particles

The sample was sealed and stored in an oven at different temperature (30-90 °C) for 24 h, and the stability to temperature was evaluated by the relative change rate of particle size (S_T) as given by equation (1) [21]. The sample was centrifuged at different speeds (1000-5000 rpm) for 30min, and the particle size of the sample in the upper and bottom of the centrifugal tube was tested, respectively. The centrifugal stability was evaluated by the relative change rate of particle size (S_C) as given by equation (2) [21].

$$S_T = \left(1 - \frac{|D_0 - D_1|}{D_0}\right) \times 100\% \quad (1)$$

$$S_C = \left(1 - \frac{|d_u - d_b|}{d_b}\right) \times 100\% \quad (2)$$

where the D_0 is the particles size before treatment, D_1 is the particle size after treatment. d_u is the particle size of the sample in the upper of centrifugal tube, d_b is the particle size

of the sample in the bottom of centrifugal tube. The larger values of S_C and S_T , the better the stability.

Solvent Resistance of Colored Latex Membranes

The prepared membranes were immersed (1mg colored latex membrane into 1 ml solvent) in different solvents for 10 days at room temperature. The solvent resistance of membranes was studied by measuring the UV absorption of solvent, considering the dissolution of the polymer fraction can increase the absorbance of the solvent. The solvent resistance of the colored latex membranes was calculated as equation (3) [22]. The absorbance of different solvents was measured every 2 days until the 10th day.

$$\text{Solvent resistance} = \left(1 - \frac{A_1}{A_0}\right) \times 100\% \quad (3)$$

where A_1 and A_0 are the changes of solvent absorbance in contact with a defined weight of membrane after and before 10 days of exposure, respectively.

Rubbing Fastness and Hand Feel

Dry rubbing tests were conducted using a rubbing fastness tester (Y5711, Darong Textile Instrument Co., Ltd., China). The finger of the tester carrying a weight of 2N was brought into contact with the test specimen, and moved to and fro along the length of the specimen for a distance of 10 cm. The rubbing process was repeated 10 times. Wet rubbing tests were conducted in the same manner as the dry rubbing tests. Before the tests, the rubbing fabrics were soaked in distilled water, and their moisture content was conditioned to approximately 100%. Rubbing fastness was determined according to the respective international standards: Color Fastness to Rubbing ISO 105-X12:2016. The cotton fabric before and after printed were cut into 20×20 cm pieces. Hand feel was tested using KESEB3-ATUO-A and KESFB2-ATUO-A instrument (KES-FB, Kato Giken Co., Ltd., Japan).

Results and Discussion

Spectral Properties

Figure 2 shows a synthesis route of modified C.I. Disperse Red 60. To introduce the C=C bonds, acryloyl chloride was used to modify C.I. Disperse Red 60 via an amidation

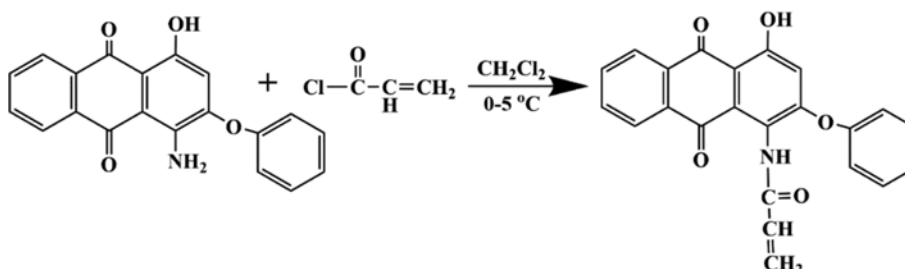


Figure 2. Synthesis route of modified C.I. Disperse Red 60.

reaction. As shown in Figure 3, the UV-vis absorption spectra of modified C.I. Disperse Red 60 was measured using DLM as a solvent. Maximum absorption wavelength (λ_{max}) of modified C.I. Disperse Red 60 is 470 nm, which is slightly smaller (40 nm) than C.I. Disperse Red 60 (510 nm), showing a hypsochromic shift [23]. This phenomenon is attributed to the introduction of electron withdrawing group (acryloyl group) reduces the electron density of modified C.I. Disperse Red 60. In order to investigate the effect of different polarity solvents on UV-vis absorption spectra of modified C.I. Disperse Red 60, the molar extinction coefficient (ϵ) and λ_{max} were measured at room temperature (Table 3). It was found that λ_{max} of modified C.I. Disperse Red 60 increases in the order: DMF>THF>DLM. Dyes showed a larger bathochromic shift in the stronger polar

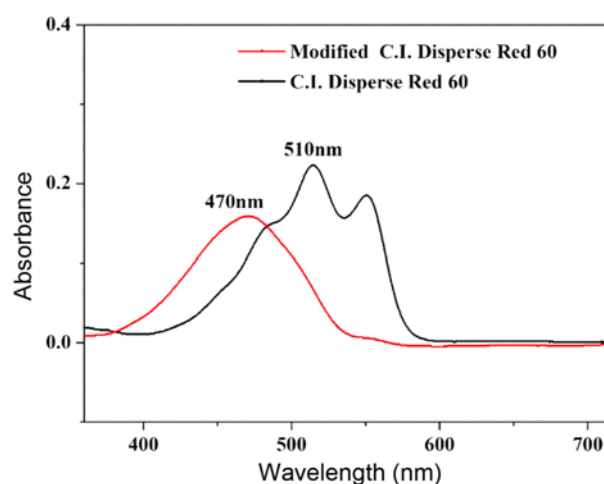


Figure 3. UV-vis spectra of C.I. Disperse Red 60 and modified C.I. Disperse Red 60 (The solvent is dichloromethane and the concentration is 1×10^{-5} mol/L).

Table 3. Spectra data of modified C.I. Disperse Red 60 in different solvents

Solvent	Polarity	λ_{max} (nm)	ϵ (L mol ⁻¹ cm ⁻¹)
DMF	6.4	516	14400
THF	4.2	487	14425
DLM	3.4	470	14385

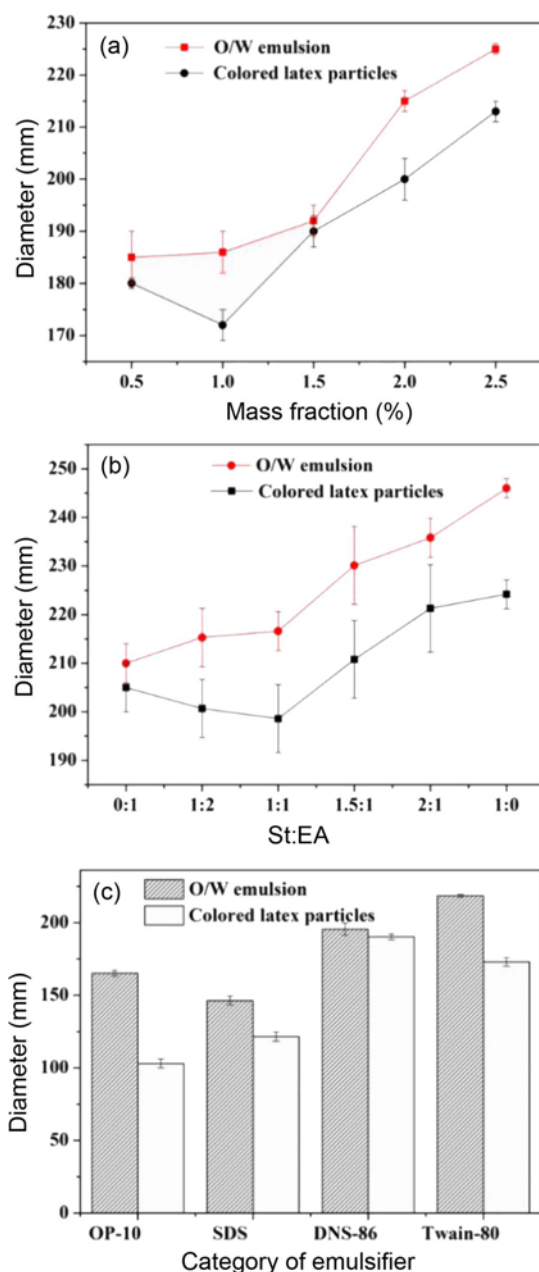


Figure 4. Effect of (a) mass fraction of modified C.I. Disperse Red 60, (b) monomer ratio, and (c) emulsifier type on the mean particle size of O/W emulsion and colored latex particles.

Table 4. Effect of monomer ratios on film-forming property of colored latex particles

St: EA	Membranous
0:1	Soft, sticky, hands
1:2	Soft, sticky, hands
1:1	Soft, sticky, no hands
3:2	Hard, no sticky
2:1	Hard, no sticky

solvent, DMF, than in the weaker polar solvents, such as THF and DLM. It can be interpreted as dipole-dipole interaction [24] between modified C.I. Disperse Red 60 and polar solvents.

Preparation and Characterization of the Colored Latex Particles

To obtain stability colored latex particles, the reaction conditions were optimized. As shown in Figure 4, the mean particle size of O/W emulsion increases with a rise in mass fraction of modified C.I. Disperse Red 60, while the mean particle size of colored latex particles decreases first and reaches a minimum value at the mass fraction around 1.0%. It can be ascribed to the fact that small amount of modified C.I. Disperse Red 60 is insufficient to support copolymerization, resulting in a small mean particle size. When the mass fraction is 1.5%, the mean particle size of O/W emulsion is close to that of colored latex particles. This is mainly because sufficient dyes can participate in copolymerization and the monomer droplets have been completely converted into the colored latex particles.

As shown in Figure 4b, the effect of mass ratios (St: EA) on the mean particle size of O/W emulsion and colored latex particles were studied. It can be seen that the mass ratio of St to EA has little influence on the mean particle size of O/W emulsion and colored latex particles. However, different mass ratios greatly affect the film forming property of colored latex particles (Table 4). A hard membrane is formed with $m_{St}: m_{EA}$ of 1.5:1 and 2:1 due to a hard monomer of St. When the mass ratio of St to EA is 1:1, the membrane exhibits a soft and sticky membrane, which is suitable for applying on printing.

The effect of the different emulsifiers on the particle size of the O/W emulsion and the colored latex particles was investigated, as shown in Figure 4c. The particle size difference between O/W emulsion and colored latex particles is the smallest when using DNS-86 as an emulsifier, which indicates that all the monomer droplets were transformed to particles without further nucleation. This can be explained by considering the long polyethylene molecular chains and hydrophobic chain segments. Moreover, as a reactive emulsifier [25], DNS-86 which can copolymerize with St, EA and modified C.I. Disperse Red 60 to further efficiently prepare colored latex particles.

The chemical structure of the prepared colored latex particles was characterized by FT-IR, DSC, TG and TEM (Figure 5). As shown in the spectra of FT-IR (Figure 5a), absorption peaks of the colored latex particles and P(St-co-EA) are observed at 1151 cm^{-1} (-C-O-C-), 1725 cm^{-1} (-C=O-) and 2920 cm^{-1} (-CH₃, -CH₂), which are assigned to the St and EA characteristic peaks. Moreover, the new absorption peaks are observed at 3216 cm^{-1} and 1550 cm^{-1} in the colored latex particles, which are the -OH and -NH- groups of modified C.I. Disperse Red 60 (Figure 1a).

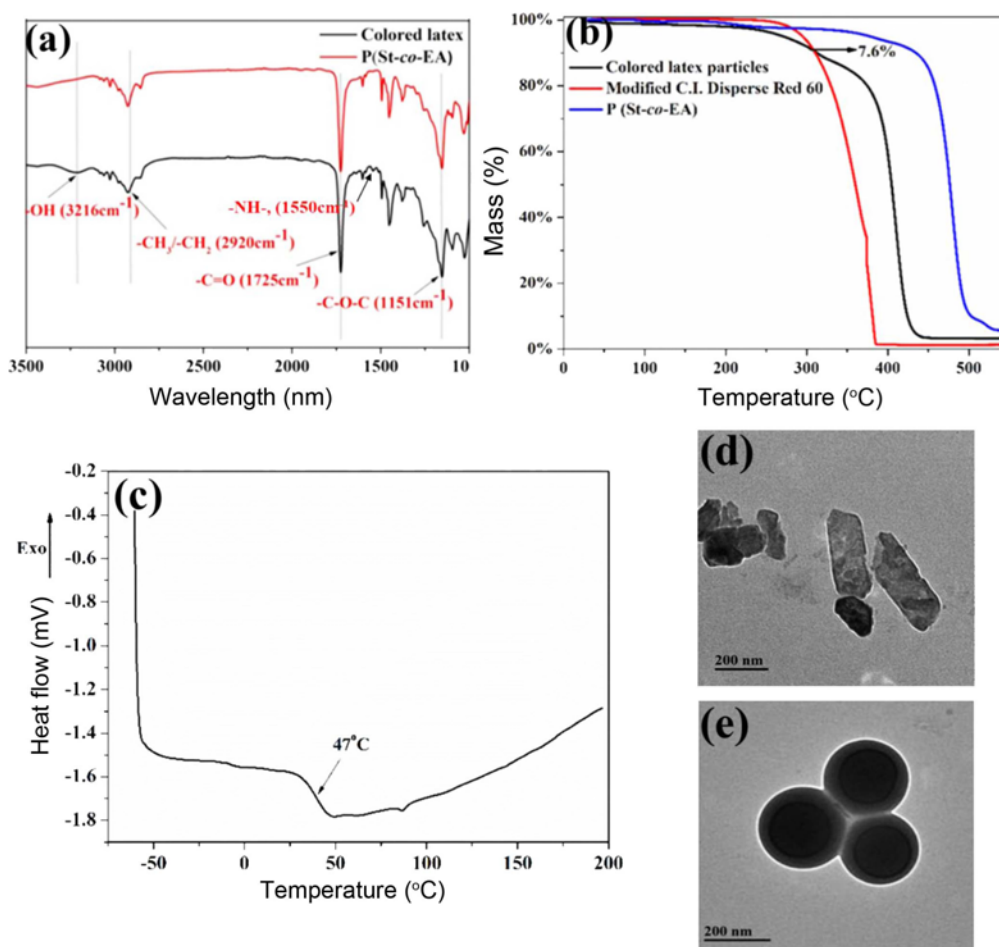


Figure 5. (a) The FTIR spectra of colored latex particles and P(St-co-EA), (b) The TGA curves of modified C.I. Disperse Red 60, colored latex particles and P(St-co-EA), (c) The DSC curve of colored latex particles, TEM images of (d) C.I. Disperse Red 60, and (e) colored latex particles.

The amount of modified C.I. Disperse Red 60 in colored latex particles was determined by using TGA spectra as shown in Figure 5b. It can be seen that a weight loss of 7.6% at the range of 300–320 °C is observed in colored latex particles, which can be attributed to the decomposition of modified C.I. Disperse Red 60. A weight decomposition of 92.4% is recorded in the range of 413–450 °C, which can be attributed to the pyrolysis of copolymers P(St-co-EA). Therefore, it can be concluded that the modified C.I. Disperse Red 60 was successfully copolymerized with St and EA and the content was evaluated to be 92.4%.

DSC measurement is an effective method for determining the glass transition temperature (T_g) and physical changes of polymers. As seen in Figure 5c, an obvious exothermic peak appears in 47 °C. Theoretically, the T_g of the homopolymers St and EA are 100 and -22 °C, respectively. However, both of them did not appear in the DSC curve of colored latex particles in this experiment. This result indicated that T_g of the colored latex particles was 47 °C. Moreover, it also

provided a meaningful evidence that modified C.I. Disperse Red 60 have been successfully copolymerized with St and EA.

The morphologies of C.I. Disperse Red 60 (Figure 5d) and colored latex (Figure 5e) particles were characterized by TEM microscopy. C.I. Disperse Red 60 exhibits an irregular long strip shape and the colored latex particles are the uniform sphere shape. Furthermore, compared with C.I. Disperse Red 60, the surfaces of colored latex particles are relatively smooth, which is attributed to the rough surfaces of the dyes were covered with the polymer.

Stability of Colored Latex Particles

The thermal stability (Figure 6a) and centrifugal stability (Figure 6b) of colored latex particles dispersion were tested. As the centrifugal rate increases from 1000 rpm to 5000 rpm, the centrifugal stability slightly declines to 90.3%. In addition, the temperature stability of colored latex particles dispersion reduces to 96.2% gradually when the temperature

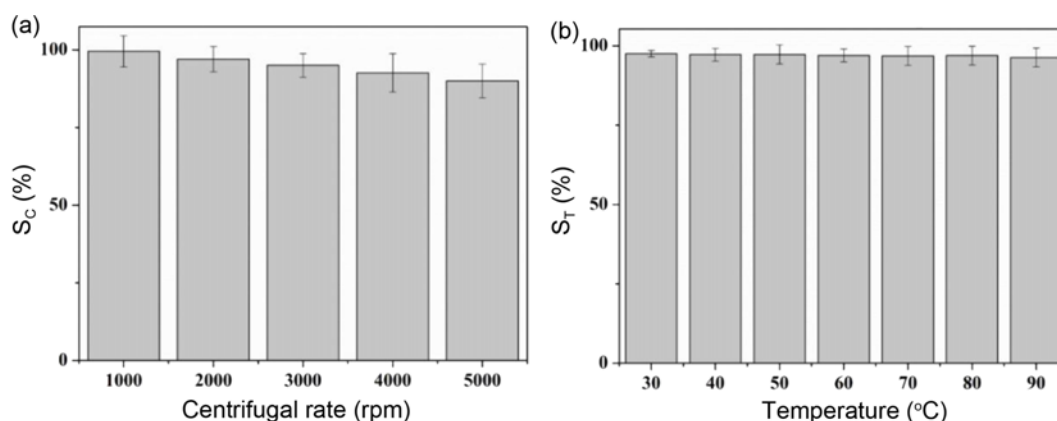


Figure 6. (a) Centrifugal stability and (b) thermal stability of colored latex particles.

increasing from 30 °C to 90 °C. The stability results indicated that the colored latex particles had high dispersion stability. The phenomenon that no aggregation of the colored latex particles can be regarded as the evidence of complete coverage of the particles with polymer, as incompletely covered particles tend to agglomerate caused by attractive London forces between the particles.

Solvent Resistance of Colored Latex Membranes

Solvent resistance tests give valuable evidence that modified C.I. Disperse Red 60 and monomers copolymerization occurred. Therefore, the solvent resistance of colored latex membranes in different organic solvents (petroleum ether, hexane, cyclohexane, and ethanol) were measured and the results are shown in Figure 7. After immersion into different organic solvents for 10 days, the solvent resistance of the colored latex membranes can remain above 98.2 %, 97.3 %, 96.5 % and 85.2 % in four organic solvents, respectively. Generally, the degree of solubility depends on

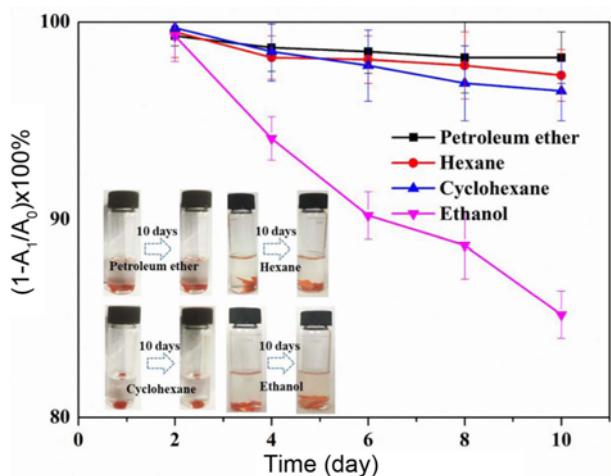


Figure 7. Solvent resistance of colored latex membranes in different solvents.

the intermolecular interaction between the solute and solvent. Due to the presence of chemical bonds of modified C.I. Disperse Red 60 and polymers, intermolecular interaction between the modified C.I. Disperse Red 60 and solvent is weakened. The solvent resistance tests also suggested that the colored latex particles have sufficient stability in the presence of organic solvents.

Properties of the Printed Fabrics

C.I. Disperse Red 60 has no affinity with cotton fabric, and the binders must be added to fix colorant on fabric surface, which will seriously lead to stiff hand feel and poor rubbing fastness for the printings. In this paper, the prepared colored latex particles have film forming monomers (St: EA=1:1), which can provide the adhesion between cotton fabric and colored latex particles. Therefore, the printed fabrics were obtained in the absence of binder.

The surface morphologies of the colored latex particles printed fabric and conventional printed fabric were observed by SEM images as shown in Figure 8. It can be seen that the surfaces of two fabrics are covered by a layer of membrane. Compared with the conventional printed fabric (Figure 8c), the collapsed colored latex particles and a compact membrane (Figure 8d) appear on the surface of fabric. This result may be attributed to the colored latex particles have an excellent dispersion ability, resulting in uniform distribution of colored latex particles. Afterwards, because each particles can be formed into a membrane, the continuous membranes can be formed on the surface of fabric.

Rubbing fastness and hand feel properties are important indexes to evaluate the quality of printing. Therefore, rubbing fastness and hand feel of the printed fabric were tested (Table 5). In the bending behavior test, the lower the bending hysteresis (2HB) value, the better the responsiveness after deformation. Compared with conventional printed fabric (0.09 and 0.07 N cm/cm in warp and weft direction, respectively), the 2HB values of colored latex particles printed fabric (0.08 and 0.02 N cm/cm in warp and weft

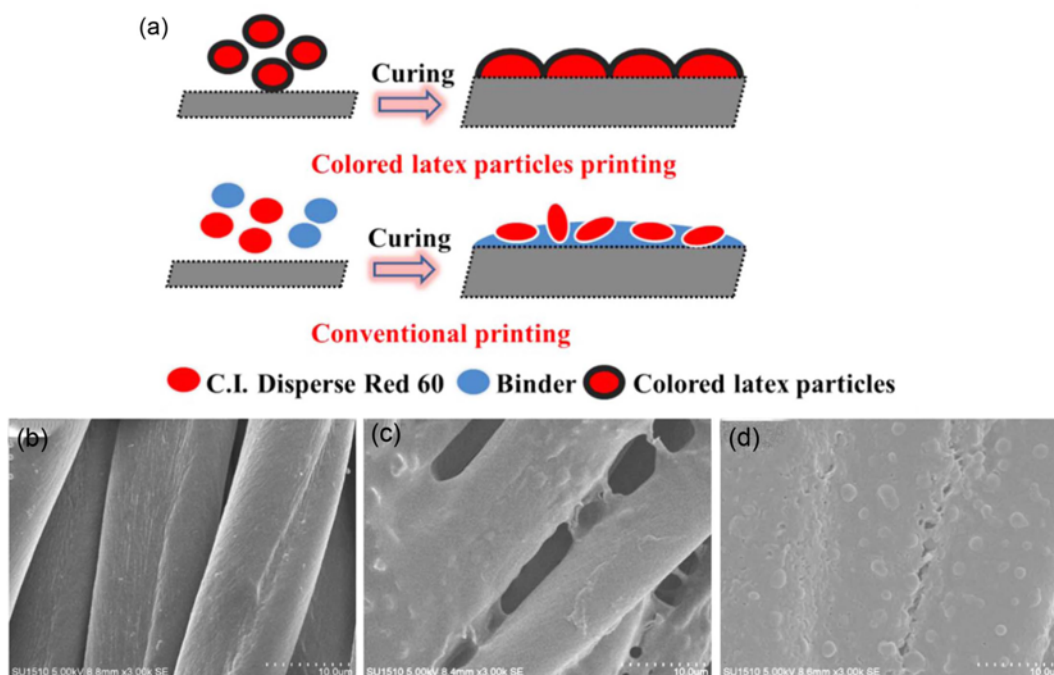


Figure 8. (a) Processes of colored latex particles printing and conventional printing, SEM images of (b) cotton fabric, (c) conventional printed fabric, and (d) colored latex particles printed fabric.

Table 5. Color fastness and hand feel of the printed fabric

Properties		Blank	Colored latex printing	Conventional printing
Bending behavior	Warp	B ^a	0.08	0.08
		2HB ^b	0.02	0.06
	Weft	B ^a	0.01	0.03
		2HB ^b	0.02	0.02
Compression behavior	LC ^c	0.24	0.21	0.13
	WC ^d	0.20	0.14	0.09
	RC ^e	28.01	20.61	15.07
Rubbing fastness	Dry	-	4-5	3
	Wet	-	2	1-2

^aB (N cm/cm) is bending rigidity, ^b2HB (N cm/cm) is bending hysteresis, ^cLC is compression linearity, ^dWC (N cm/cm) is compression ratio, ^eRC (%) is compression resilience.

direction, respectively) are lower, exhibiting an excellent responsiveness after deformation. Meanwhile, the 2HB values of the weft are lower than the warp. It is attributed to the tighter structure in the warp than the weft direction, resulting in the poor responsiveness after bending deformation. The larger the value of compression ratio (WC) and compression resilience (RC), the more fluffy and elastic of the fabric. It can be seen that the WC and RC of the colored latex particles printed fabric (WC is 0.14 N cm/cm² and RC

is 15.07 %) are larger than conventional printed fabric (WC is 0.09 N cm/cm² and RC is 20.61 %). This is mainly because the fabric has a smaller resistance to bending and a greater compression behavior after colored latex particles printing, which inevitably leads to better hand feel. The rubbing fastness of printed fabrics were tested. The results indicate that the printed fabric of colored latex particles had better rubbing fastness than the conventional printed fabric. This can be attributed to the film forming polymer which ensures the colored latex particles to be tightly adhered to fabric surface.

Conclusion

This study reports the synthesis of a polymerization dye by chemical modification which can be used as a comonomer along with St and EA to prepare the covalent colored latex particles. The FT-IR, TEM, TGA, DSC analysis revealed that the monomers were covalently bonded to modified C.I. Disperse Red 60. Because of the covalent bond between modified C.I. Disperse Red 60 and monomers, the prepared colored latex particles had high solvent resistance in different organic solvents. In addition, the prepared colored latex particles had film-forming polymers, and the colored latex particles were used for printing under a without binder condition. Compared with conventional printed fabrics, colored latex particles printed fabric showed a soft hand feel and the better rubbing fastness. We believe that it also

provides a new idea for textile printing.

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