1. Introduction

Polymer gels have characteristic three-dimensional network structure that is usually synthesized by crosslinking monomers in chemical ways. Nanofibers made from many polymer materials have many perspective applications, for example in chemicals and dust removal filters, catalyst or active substance carriers, biosensors, and biofilters [1‒11]. However, for polymer gels, fiber manufacturing is quite difficult due to their three-dimensional network structure stemming from chemical crosslinking. The three-dimensional network structure causes them only swell but unable to dissolve in solvents, as well as to melt by heating. Wet, dry, melt and electrospinnings are widely used for general polymer fiber production [12‒15]. The former three methods, wet, dry and melt spinnings, require polymer solution or melt as spinning materials, whereas for polymer gels, neither solution nor melt can be prepared due to their chemically crosslinked network structure. For this reason, wet, dry and melt spinnings can not be used to fabricate polymer gel fibers. Electrospinning (ES) seems to be a possible approach expected to make polymer gel fibers, because except for polymer solution and polymer melt, ES also allows using material if only it is in liquid state as spinning materials [16‒21]. In this paper, we come up with using reactions of polymer gels in liquid state as spinning raw materials to produce polymer gel fibers; these reactions are typically composed of monomer(s), crosslinker and initiator. Another key point to produce polymer gel fibers is to have polymerization (i.e., gelation) process proceed while spinning. To this end, we employ an ultraviolet (UV) irradiator between the nozzle and the target (fiber collector) to make sure the gelation undergo at the same time with the spinning. We abbreviate this fiber manufacturing method as UV-reactive electrospinning (UV-ES).
technique 'UV-reactive electrospinning' to UV-ES. The UV-ES method is expected a promising approach to manufacturing polymer gel fibers effectively, in addition, at room temperature and under atmosphere pressure. We perform the spinning experiments using two polymer gels via UV-ES under different conditions including changing viscosity of gel reactions, applied voltage, distance from the tip of needle to collector, and flow rate. The influence of spinning conditions on the morphology and diameter of polymer gel fibers is discussed. In this work, we aim to discuss the achievability of the UV-ES method, and whether the UV-ES method is possible to be a potentially practical and effective approach for manufacturing fibers of polymer gels with chemically crosslinked structure.

2. Experimental

2.1 Materials

N, N-dimethylacrylamide (DMAA), stearyl acrylate (SA) and dodecyl acrylate (DA) were provided by Tokyo Chemical Industry Co., Ltd., Tokyo, Japan and used as monomers. The crosslinker N,N'-methylenebisacrylamide (MBAA), photo-induced polymerization initiator benzophenone (BP) were purchased from FUJIFILM Wako Pure Chemical Corporation, Osaka, Japan. All the above reagents were used without any further purification.

2.2 Preparation of gel reactions with a different viscosity

To prepare gel reactions using for UV-ES, first, into a 50 mL snap vial were placed monomer (or monomers), crosslinker and initiator. The mixture was stirred for 30 minutes to ensure complete dissolution of solid reagents and thus homogeneous liquid was obtained. Immediately after mixing, the mixture shows quite low viscosity like water. Because too-low viscosity leads to only the formation of droplets but not fibers, so that the prepared reactive mixture is still not suitable for UV-ES. By the same token, a too-high viscosity is also not suitable for UV-ES for the reason that it may easily cause nozzle clogging [4, 22]. The viscosity of the reactive mixture becomes higher with prepolymerization treatment. Therefore, in order to prepare gel reactions with a suitable viscosity for spinning, we pre-photopolymerized the reactive mixture to make monomers convert to oligomers to raise its viscosity. An UV irradiator (NS-Lighting Co., LTD, Osaka, Japan, illuminance 4000 mWcm⁻²) was employed to run the pre-photopolymerization. Longer UV irradiation time results in higher viscosity. In this way, we prepared gel reactions with a different viscosity ranging 80 mPas ~1700 mPas. The resultant gel reactions were used for UV-ES as raw spinning materials. Their viscosity was measured by vibration-type viscometer for lab (VM-10 A-M, measurement range 10~5000 mPas, Sekonic Corporation, Tokyo, Japan).

Two kinds of polymer gels were used for UV-ES in this work. One was amorphous homopolymer gel poly (N, N-dimethylacrylamide) (G(DMAA)) synthesized from one monomer DMAA that is our main investigation subject. For comparison, the other crystalline copolymer gel poly (DMAA-stearyl acrylate-dodecyl acrylate) (G(DMAA-SA-DA)) synthesized from three monomers DMAA, SA and DA was also spun in the aim of verifying the practicability of the UV-ES method. We have developed functionalized polymer gels through introducing crystalline side chains into three-dimensional network structure of gels. The

![Fig. 1 Synthesis scheme of the polymer gels G(DMAA) and G(DMAA-SA-DA). G(DMAA) is amorphous and G(DMAA-SA-DA) is crystalline. The long alkane chain stemming from SA and DA provides G(DMAA-SA-DA) crystallinity.](image)
introduction of crystalline structure provides polymer gels multiproperties such as high strength and flexibility, thermal energy storage, thermal expansion, and shape memory property [23–26]. If the fiber manufacturing for crystalline gel G(DMAA-SA-DA) is achievable, the UV-ES technique should enable more versatile usage for more polymer gels as a potentially effective fiber manufacturing approach. The molar ratio of DMAA:SA:DA was 3.0:0.7:0.3. The amount of crosslinker and initiator were 0.05 mol% and 0.1 mol% of total monomers respectively for both G(DMAA) and G(DMAA-SA-DA). The synthesis scheme of G(DMAA) and G(DMAA-SA-DA) is shown in Fig. 1. The structure of SA and DA consist of a long alkane chain with 18 and 12 methylene units respectively. The long alkane chain provides G(DMAA-SA-DA) crystallinity.

2.3 UV-reactive electrospinning (UV-ES)

The schematic of UV-ES of polymer gel fibers is shown in Fig. 2. The UV-ES method uses an electric field to draw fine fibers from the nozzle. The photocrosspolymerized gel reactions prepared in 2.2 were then transferred into a syringe equipped with a 21-gauge stainless steel needle and infused at a constant rate with a syringe micropump (NE-4000, Neuro Science, Inc., Tokyo, Japan). A positive bias of 10–30 kV was applied to the needle. The collector position was varied from 10 cm to 30 cm from the tip of the needle. The UV light from an irradiator (NS-Lighting Co., LTD, Osaka, Japan, illuminance 4000 mW·cm⁻²) was irradiated directly on the jet traveling from the needle to the collector. Upon UV irradiation, the further polymerization of gel reaction carried out while the jet was traveling to the collector. The UV-ES underwent at a temperature of 18–23 °C, relative humidity of 30–47 %, and other detailed conditions are shown in Table 1.

![Fig. 2](image)

**Table 1** Detailed conditions of UV-ES for two polymer gels.

| Gel             | No. | η (mPars) | V (kV) | D (cm) | V/D (kV/cm⁻¹) | ν (µℓ·min⁻¹) |
|-----------------|-----|-----------|--------|--------|---------------|--------------|
| G(DMAA)         | 1-1 | 100       | 10     | 30     | 0.33          | 120          |
|                 | 1-2 | 300       |        |        |               |              |
|                 | 1-3 | 500       |        |        |               |              |
|                 | 1-4 | 600       |        |        |               |              |
|                 | 1-5 | 800       |        |        |               |              |
|                 | 1-6 | 1700      |        |        |               |              |
|                 | 1-7 | 300       |        |        |               |              |
|                 | 1-8 | 500       |        |        |               |              |
|                 | 1-9 | 700       |        |        |               |              |
|                 | 1-10| 150       |        |        |               |              |
|                 | 1-11| 500       |        |        |               |              |
|                 | 1-12| 600       |        |        |               |              |
| G(DMAA-SA-DA)   | 2   | 100       | 10     | 10     | 1.00          | 12           |

Note: η - viscosity of gel reaction, and the error range is ±(10~20) mPars; V - applied voltage; D - distance from the tip of nozzle to collector; V/D - electric field intensity, the value of V divided by D; ν - flow rate.
2.4 Characterization

The samples deposited on the collector were collected and used for characterizations. Fiber morphology and surface feature were observed on a scanning electron microscope (SEM) (JSM-5510, JEOL Ltd, Tokyo, Japan) and a transmission electron microscope (TEM) (JEM-2100 F, JEOL Ltd, Tokyo, Japan). The chemical structure of polymer gel fibers was evaluated using a Fourier transform infrared spectrometer (FTIR) (FT/IR-460 Plus, JASCO International Co., Ltd., Tokyo, Japan). The spectra were recorded with 32 scans in transmittance mode with a resolution of 0.5 cm⁻¹ within the range of 500 cm⁻¹ to 3400 cm⁻¹. To evaluate the crystal structure of polymer gel fibers spun via UV-ES, differential scanning calorimeter (DSC) (Q-2000, TA instruments Japan Inc., Tokyo, Japan) was performed under a nitrogen flow. Samples of about 5 mg were heated to 150 °C at a heating rate of 5 °C·min⁻¹, and held for 1 min to eliminate the thermal prehistory. Then, samples were cooled down to -50 °C at a cooling rate of 5 °C·min⁻¹. After holding for 1 min, samples were reheated up to 150 °C at the same heating rate of 5 °C·min⁻¹. Premium hermetic pans (TA Instruments Tzero #90163.901, TA instruments Japan Inc., Tokyo, Japan) were used for the measurements. To determine the crystal structure, wide-angle X-ray scattering (WAXS) was performed on an X-ray diffractometer (Ultima IV, Rigaku Corporation, Akishima, Japan) with nickel-filtered Cu-Kα radiation (wave length λ = 1.5405 Å) and a high-speed one-dimensional detector (D/ tex Ultra, Rigaku Corporation, Akishima, Japan) at a scanning rate of 5 °·min⁻¹.

3. Results and discussion

3.1 Influence of viscosity of gel reactions

In order to investigate the influence of the viscosity of gel reactions on fiber diameter and morphology for G(DMAA), we performed UV-ES under the conditions of No. 1-1~1-6 tabulated in Table 1. Six gel reactions with a viscosity of 100 mPa·s, 300 mPa·s, 500 mPa·s, 600 mPa·s, 800 mPa·s, and 1700 mPa·s were prepared and used for UV-ES. 1700 mPa·s is the highest viscosity enabling the UV-ES undergo smoothly without nozzle clogging. A viscosity more than 1700 mPa·s is too high because the gel reactions can not be pushed out of the nozzle. Fibers deposited on the collector were used for observation. Fig. 3 shows the representative images of G(DMAA) fibers. Low viscosity gel reactions, such as 100 mPas and 300 mPas, just formed droplets like electrospraying. This result is consistent with the observations reported previously by others that lower viscosity does not favor formation of fiber [27-31]. As the viscosity increased, at a viscosity of 500 mPas, nanofibers of 2~250 nm in diameter were obtained. The fibers were nanoscale so we made observations on a TEM (Fig. 3 (a) (b)). Spindle-like beads were also found in rare cases. When the viscosity increased to 600 mPas, besides samples deposited on the collector, we could directly see a membrane like a spider web that was fabricated during the space of between the nozzle and the collector (Fig. 3 (c)). We took samples both from the collector and membrane and observed them. In Fig. 3 (d), the morphology of the sample collected from the collector is shown. It was clearly found that both beads and fibers were formed. The diameter of beads ranges 1~15 µm. To look fibers more closely, the magnified picture of fibers is shown in Fig. 3 (f). It indicated the fibers have a diameter of 5~400 nm. Fig. 3 (e) is the morphology of the membrane sample. The fibers have the same diameter range of 5~400 nm, while the beads show slightly larger diameter of 5~20 µm compared to the sample from the collector, additionally, the beads are beaded fibers. We speculate larger beaded fibers play a role in the membrane to construct and support the web structure like as a strengthened frame. For practical applications, it will be important to explore the difference in structure depending on the distance. Research related to this aspect is currently being investigated and will be reported in the near future.

In case of the viscosity further increased to 800 mPas, looped fibers tended to be formed, meanwhile beads disappeared (Fig. 3 (g)). The diameter of the fibers became bigger ranging 1 µm up to 5 µm. Fig. 3 (h) displays a exemplary TEM image of these looped fibers. Interestingly, three thin fibers with a diameter of 50 nm, 90 nm and 110 nm (dark lines) seem to be inside the thick fiber with a diameter of 590 nm (relatively light line). Thicker fibers are likely composed of thinner fibers. As a result, we consider that the looped fibers may have broader range of 50 nm ~ 5 µm in diameter at a viscosity of 800 mPas. When the viscosity increased up to the highest value of 1700 mPas, micrometer scale fibers with 1~5.5 µm in diameter were produced as shown in Fig. 3 (i) and (j). They are looped fibers likewise.
Fig. 3 The morphology spun from gel reactions with a different viscosity for G(DMAA). The electric field intensity is 0.33 kV·cm⁻¹. (a) (b) Nanofibers at 500 mPa·s. The fibers are nanoscale (2~250 nm) so we made observations on a TEM; (c) Membrane like a spider web formed during the space of between the nozzle and the collector at 600 mPa·s; (d) Morphology of the sample collected from the collector at 600 mPa·s; (e) SEM image of (c); (f) SEM image of the fibers in (d) in a large vision field; (g) Looped fibers and (h) a magnified picture observed on a TEM of a fiber at 800 mPa·s; (i) and (j) Loopeds microfibers at 1700 mPa·s.
The viscosity of gel reactions affected the diameter of G(DMAA) fibers obviously. With the viscosity increasing, the diameter of fibers became bigger from nanoscale (2~250 nm at 500 mPa·s) to microscale (up to 5.5 µm at 1700 mPa·s), and the diameter range became boarder. Even though beads and beaded fibers were formed at a middle viscosity of 600 mPa·s, the fibers were produced successfully using more viscous gel reactions from 500 mPa·s polymer gel G(DMAA) via the UV-ES technique.

3.2 Influence of electric field intensity

By varying the electric field intensity from 0.33 kV·cm⁻¹ to 0.50 kV·cm⁻¹ and 3.00 kV·cm⁻¹ while holding the flow rate constant, UV-ES were performed using gel reactions with a different viscosity to investigate the influence of the electric field intensity on fiber diameter and morphology for G(DMAA). Three gel reactions with a viscosity of 300 mPa·s, 500 mPa·s and 700 mPa·s were used under an electric field intensity of 0.50 kV·cm⁻¹ (No. 1-7, 1-8 and 1-9 in Table 1). Similar to the case of 0.33 kV·cm⁻¹ described in 3.1, fibers were not also formed at a lower viscosity of 300 mPa·s even under a higher electric field intensity of 0.50 kV·cm⁻¹. Fig. 4 shows the morphology for G(DMAA) spun at a viscosity of 500 mPa·s and 700 mPa·s. For the two more viscous gel reactions, fibers were obtained. The diameter of fibers ranges from ~50~500 nm at 500 mPa·s. Note, most fibers were entangled together, and some spindle-like beads incorporated into fibers were also found (Fig. 4 (a) (b)). By contrast, fibers with a larger diameter of 1~3.5 µm were observed at 700 mPa·s (Fig. 4 (c) (d)). Moreover, the fibers formed porous structure by crossing and bonding between the fibers. The pores exhibited a diameter of 1~10 µm. Clearly, higher viscosity resulted in an increase in diameter of fibers.

Under a further higher electric field intensity of 3.00 kV·cm⁻¹, gel reactions with a viscosity of 150 mPa·s, 500 mPa·s and 600 mPa·s (No. 1-10, 1-11 and 1-12 in Table 1) were used to perform the UV-ES for G(DMAA). The results revealed that a viscosity of 150 mPa·s was also too low to make fibers form. A viscosity of 500 mPa·s and 600 mPa·s was found suitable for fibers manufacturing. We could see the surface of the collector became white because it was covered with fibers, as shown in Fig. 5 (a). The fibers deposited on the collector were observed on a SEM. The SEM image (Fig. 5 (b)) illustrated uniform fibers of 150~400 nm in diameter were deposited at a viscosity of 500 mPa·s. Fig. 5 (c) and (d) show the fiber spun at a viscosity of 600 mPa·s. Uniform fibers with two diameter ranges, one is 50~100 nm, the other is 150~400 nm, were observed. Most of fibers were fibers of 150~400 nm in diameter, only a small amount of fibers were 50~100 nm in diameter. It is noteworthy that the fibers of 150~400 nm in diameter seem to be partially hollow-core (Fig. 5 (d)). To obtain further insights into this structure, we plan to do...
further investigations next to make it clear whether the fibers are hollow-core.

We plotted the fiber diameter vs. the viscosity of gel reactions under all the three investigated electric field intensities of 0.33, 0.50 and 3.00 kV·cm⁻¹ on the same graph (Fig. 6 (a)) to see if there is a regularity impact of viscosity on fiber diameter. In general, the fiber diameter tended to increase with the increase of viscosity regardless of the electric field intensity. Gel reactions less viscous than 300 mPa·s could not be spun to form fibers. Nanoscale fibers with a diameter less than 500 nm were fabricated at a viscosity of 500 mPa·s and 600 mPa·s, while microscale fibers with a diameter up to nearly 5.5 μm were obtained at a viscosity of 700 mPa·s and higher. We show Fig. 6 (b) to give a detailed look at a viscosity of 500 and 600 mPa·s. Obvious dependency of applied electric field intensity on diameter range of fibers was not found, but higher electric field intensity seems to result in an increase in the minimum diameter of fibers.
3.3 Influence of gel composition

In order to verify the universal applicability of the UV-ES method for fiber manufacturing of polymer gels, the UV-ES was also conducted for copolymer crystalline gel G(DMAA-SA-DA) under the condition of No. 2 in Table 1. The gel reaction with a low viscosity of 100 mPa·s was used, so accordingly, we lowered the flow rate down to 12 µℓ·min⁻¹. Fig. 7 (a) is the picture of the spun fibers deposited on collector. G(DMAA-SA-DA) fibers could be clearly seen by the visual check with naked eyes. The SEM image, shown in Fig. 7 (b), illustrated that the diameter of G(DMAA-SA-DA) fibers was in the range of 30~100 µm. The reason why the formed fibers are so larger is still not clear, further investigation should be continued. Higher-magnification images of the surface of these fibers are shown in Fig. 7 (c), (d) and (e) in an effort to observe the fibers with higher resolution. It was found that the surface of the fibers was not smooth, but covered with small protuberances of around 1 µm. Further magnified SEM image (Fig. 7 (e)) clearly showed there were nanometer-order wave-like patterns on the surface of protuberances for G(DMAA-SA-DA) fibers. The gel reaction even with such a low viscosity of 100 mPa·s that failed to spin G(DMAA) presented successful fiber formation for G(DMAA-SA-DA). One possible reason is thought that crystalline side chains stemming from SA and DA contribute to fix the shape of fibers due to the crystallization effect. From the success spinning of crystalline G(DMAA-SA-DA), we envisioned that the UV-ES method would expand the possibilities of fibers manufacturing for many more polymer gels.

3.4 Structure analysis

As shown in Fig. 1, monomers and crosslinker used to form polymer gels possess vinyl group which contains double bonds. With the polymerization going and in a complete polymer gel, all the double bonds are turned into single bonds. To analyze the structure change, the spun G(DMAA) and G(DMAA-SA-DA) fibers was evaluated by FTIR spectroscopy.

Fig. 7 SEM photographies of spun G(DMAA-SA-DA) fibers via UV-ES. The next photograph is the higher-magnification image of the preceding one. Squares on the images represent the magnified area.
Fig. 8 shows the infrared spectra of these G(DMAA) and G(DMAA-SA-DA) samples. G(DMAA) samples (Fig. 8 (a), (b), (c)) presented a strong intensive absorption peak appearing at 2925 cm\(^{-1}\) due to the alkyl C-H stretching vibrations of the methylene group stemming from DMAA. Gel reactions of G(DMAA) with a viscosity of 0 and 500 mPa·s displayed strong absorption peak at 1645 cm\(^{-1}\) for the C=O stretching vibration of the tertiary amide (-CO-N). The peak at 1607 cm\(^{-1}\) assigned to C=C stretching vibration, and other two peaks near 980 and 957 cm\(^{-1}\) assigned to C-H stretching vibration of the end vinyl group (CH\(_2=CH\)-) were characteristic absorption peaks for C=C (Fig. 8 (a), (b)). By comparison, the above three characteristic peaks for C=C disappeared in the infrared spectrum of G(DMAA) fibers spun via UV-ES (Fig. 8 (c)), exhibiting the polymerization, or gelation, or curing, was essentially completed while fabricating the fibers. It was also noted that the peak contributed to the C=O stretching vibration of the tertiary amide shifted to 1617 cm\(^{-1}\). For G(DMAA-SA-DA) samples, there were two strong alkyl C-H stretching vibration peaks of the methylene group. One was at 2915 cm\(^{-1}\) derived from DMAA, and the other was at 2850 cm\(^{-1}\) derived from SA and DA (Fig. 8 (d), (e)). The C=O stretching vibration peaks of the ester group and the tertiary amide exhibited at 1725 and 1635 cm\(^{-1}\). G(DMAA-SA-DA) likewise showed the absorption band owing to the C-H stretching vibration of the end vinyl group at 993 cm\(^{-1}\). We could clearly see the characteristic peak at 993 cm\(^{-1}\) for C=C also disappeared in the infrared spectrum of G(DMAA-SA-DA) fibers spun via UV-ES (Fig. 8 (e)). According to the above FTIR results, we can conclude that the

![Image](image_url)

**Fig. 8** FTIR spectra of G(DMAA) and G(DMAA-SA-DA) samples and their partial enlargement in the range of 930–1010 cm\(^{-1}\). Gel reaction of G(DMAA) with a viscosity of (a) 0 mPa·s (i.e., the mixture of monomer(s), initiator and crosslinker immediately after being prepared) and (b) 500 mPa·s; (c) G(DMAA) fibers spun under condition No. 1-3 in Table 1; (d) Gel reaction of G(DMAA-SA-DA) with a viscosity of 0 mPa·s; (e) G(DMAA-SA-DA) fibers spun under condition No. 2 in Table 1.

![Image](image_url)

**Fig. 9** DSC curves of G(DMAA) (No. 1-3 in Table 1) and G(DMAA-SA-DA) (No. 2 in Table 1) fibers spun via UV-ES.
polymerization both in G(DMAA) and G(DMAA-SA-DA) fibers underwent completely during the UV-ES fiber fabricating process. In order to confirm the difference in crystallinity between G(DMAA) and G(DMAA-SA-DA), DSC and WAXS were measured using their fibers spun under conditions of No. 1-3 and No. 2 shown in Table 1 respectively. The melting point is a representative parameter to determine the crystallinity of polymers. The DSC curve gives us the information about melting point, it is shown in Fig. 9. G(DMAA-SA-DA) fibers exhibited obvious melting peak in temperature range of 20~40 °C, and had a clear melting point at 33 °C. On the other hand, G(DMAA) fibers did not show melting behavior, naturally no melting peak occurred. SAXS were carried out at room temperature and the WAXS patterns are shown in Fig. 10. The sharp peak was observed at diffraction angle 2θ = 21.14° on the SAXS pattern for G(DMAA-SA-DA). This peak could be assigned to the side-chain crystal structure deriving from n-alkyl groups of SA [24]. On the other hand, for G(DMAA), two amorphous halos around 2θ = 14° and 22° could be seen, which were considered originating from amorphous structure of the pendent methyl (CH3) and acetoxy (COOCH3) groups of DMAA [25]. Therefore, it is evident that G(DMAA) fibers are amorphous and G(DMAA-SA-DA) fibers are crystalline.

4. Conclusions

The fiber manufacturing via UV-ES succeeded for both amorphous homopolymer gel G(DMAA) and crystalline copolymer gel G(DMAA-SA-DA). Fibers with a diameter ranging from 2 nm to 5.5 µm for G(DMAA) were produced under an electric field intensity of 0.33 kV/cm². We found that the viscosity of gel reactions influenced the fiber diameter greatly. Fibers were not formed in case that the viscosity was lower than 300 mPa·s. In higher viscosity range of 500 ~1700 mPAs, fibers were fabricated successfully, and the diameter of fibers increased with increasing viscosity. Nanoscale fibers with a diameter less than 500 nm were obtained at a viscosity of 500 mPAs and 600 mPAs, while microscale looped fibers with a diameter up to nearly 5.5 µm were formed at a viscosity of 700 mPAs and higher. Beads of 1~15 µm and beaded fibers of 5~20 µm in diameter were also observed at a middle viscosity of 600 mPaS. The results under different electric field intensities showed that there was no obvious dependency of the applied electric field intensity on diameter range of fibers, but higher electric field intensity seems to result in an increase in the minimum diameter of fibers. The UV-ES of crystalline copolymer gel G(DMAA-SA-DA) also succeeded. G(DMAA-SA-DA) fibers ranging 30~100 µm in diameter were observed, demonstrating the UV-ES method is a feasible solution to fiber manufacturing of polymer gels. The structure analysis evaluated by FTIR spectroscopy illustrated that the polymerization essentially completed while fabricating the fibers for both G(DMAA) and G(DMAA-SA-DA). The DSC and WAXS results made it clear that G(DMAA) fibers are amorphous and G(DMAA-SA-DA) fibers are crystalline.

This contribution reports our initial findings on fiber manufacturing for polymer gels of G(DMAA) and G(DMAA-SA-DA). We introduced a potentially effective method to prepare fibers of polymer gels with chemically crosslinked structure, that is the UV-ES method. We plan to investigate fiber manufacturing via UV-ES for more polymer gels.
particularly the functionalized crystalline polymer gels developed in our group, such as water (or oil)-absorbable gel, large stretchable gel, self-shrinkable gel, stimulative healing gel, thermal sensitive gel. We expect to create functional membranes and non-woven fabric made from these functionalized gel fibers and provide practical examples for their applications in the future.

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