Supplementary Information

Polypeptoids with Tunable Cloud Point Temperatures Synthesized from N-Substituted Glycine N-Thiocarboxyanhydrides

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Scheme S1. Synthesis of sarcosine \( N \)-thiocarboxyanhydride (Sar-NTA).

Scheme S2. Synthesis of \( N \)-butylglycine \( N \)-thiocarboxyanhydride (NBG-NTA).

Figure S1. Illustration of onset determination of transition window (\( \Delta T \)).
Figure S2. $^1$H NMR spectrum of Sar-NTA in CDCl$_3$ (*: ethyl acetate).

Figure S3. $^1$H NMR spectrum of NBG-NTA in CDCl$_3$ (*: ethyl acetate).
Table S1. Copolymerization of Sar-NTA with NBG-NTA initiated by benzylamine

<table>
<thead>
<tr>
<th>Run</th>
<th>[Sar]/[NBG]/[benzylamine]</th>
<th>Conversion (%)</th>
<th>Yield (%)</th>
<th>$M_n$ theo (kDa)</th>
<th>Copolypeptoid Composition</th>
<th>$M_n$ NMR (kDa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>117/79/1</td>
<td>75.8</td>
<td>67.2</td>
<td>11.4</td>
<td>P(Sar$<em>{95}$r-NBG$</em>{55}$)</td>
<td>13.1</td>
</tr>
</tbody>
</table>

$^a$ Polymerization conditions: [Sar]+[NBG] = 0.5 mol/L, 48 h in THF at 60 °C. $^b$ Determined by taking a small amount of reaction mixture and dissolving in DMSO-$d_6$ for $^1$H NMR analysis. Monomer conversions were calculated from the relative integration of the proton resonance of monomers and copolymers. $^c$ Defined as Equation (S1). $^d$ Calculated by $^1$H NMR analysis of isolated copolypeptoid products with DMSO-$d_6$ as the solvent.

$M_n$ theo = $\frac{[\text{Sar}]}{[\text{benzylamine}]} \times \text{Conversion}_{\text{Sar}} \times 71 + \frac{[\text{NBG}]}{[\text{benzylamine}]} \times \text{Conversion}_{\text{NBG}} \times 113 + 107$ (S1)

![Figure S4. SEC traces of samples 7–17 in Group II.](image-url)
Figure S5. SEC trace of sample 18 in Group III.

Table S2. Copolymerization of Sar-NTA with NBG-NTA for reactivity ratios measurement

<table>
<thead>
<tr>
<th>Run</th>
<th>([\text{Sar}]_0/\text{[NBG]}_0)</th>
<th>Conversion (%)b</th>
<th>Sar mol% in copolymersc</th>
<th>Copolymer composition (f)d</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2</td>
<td>4.608</td>
<td>17.4</td>
<td>88.6</td>
<td>7.802</td>
</tr>
<tr>
<td>S3</td>
<td>1.816</td>
<td>18.3</td>
<td>74.7</td>
<td>2.956</td>
</tr>
<tr>
<td>S4</td>
<td>0.983</td>
<td>17.1</td>
<td>64.0</td>
<td>1.781</td>
</tr>
<tr>
<td>S5</td>
<td>0.541</td>
<td>16.0</td>
<td>45.1</td>
<td>0.822</td>
</tr>
</tbody>
</table>

a Copolymerization were carried out in THF at 60 °C for 4 h with feed molar ratios of monomers ([Sar]+[NBG]) to initiator around 200, [Sar]+[NBG] = 0.5 mol/L; b Determined by taking a small amount of reaction mixture and dissolving in DMSO-\(d_6\) for \(^1\)H NMR analysis. Monomer conversions were calculated from the relative integration of the proton resonance of monomers and copolymers. c Calculated by \(^1\)H NMR analysis of isolated copolyypeptoid products with DMSO-\(d_6\) as the solvent. d Defined as Equation (S3).

\[
F = \frac{[\text{Sar}]_0}{[\text{NBG}]_0} \quad \text{(S2)}
\]

\[
f = \frac{\text{Sar mol% \(\text{in copolymer composition}\)}}{100 - \text{Sar mol% \(\text{in copolymer composition}\)}} \quad \text{(S3)}
\]
Figure S6. Plots of $F(f-1)/f$ versus $(F^2/f)$ for the benzylamine-initiated copolymerization of Sar-NTA with NBG-NTA and the linearly fitted line whose slope is $r_1 \ [1.70(7), \text{Sar-NTA}]$ and intercept is $r_2 \ [0.63(7), \text{NBG-NTA}]$ by the Fineman-Ross method.

Figure S7. Plots of transmittance at $\lambda = 450$ nm versus temperature for samples of Group I (1–6) with a concentration of 3.0 mg/mL during heating procedure.
Figure S8. Plots of $T_{cp}$ versus the molar fraction of Sar segment for samples of Group I (1–6) and the corresponding linearly fit curve.

Figure S9. Plots of transmittance at $\lambda = 450$ nm versus temperature for samples of 9–12 (Group II) with a concentration of 3.0 mg/mL during heating procedure.
Figure S10. Plots of transmittance at $\lambda = 450$ nm versus temperature for samples of 13–17 (Group II) with a concentration of 3.0 mg/mL during heating procedure.

Figure S11. Plots of $T_{\text{cp}}$ versus the molar fraction of Sar segment for samples of Group II (9–17) and the corresponding linearly fit curve of samples 13–17.
**Figure S12.** Plots of transmittance at $\lambda = 450$ nm *versus* temperature for the sample 5 with different concentrations (heating and cooling cycles are symbolized by the filled and unfilled symbols, respectively).

**Figure S13.** Plots of transmittance at $\lambda = 450$ nm *versus* temperature for the sample 6 of 3.0 mg/mL aqueous solution with the addition of Na$_2$SO$_4$ at various concentrations (heating and cooling cycles are symbolized by the filled and unfilled symbols, respectively).
Figure S14. Plots of transmittance at $\lambda = 450$ nm versus temperature for the sample 6 of 3.0 mg/mL aqueous solution with the addition of NaCl at various concentrations (heating and cooling cycles are symbolized by the filled and unfilled symbols, respectively).

Figure S15. Plots of transmittance at $\lambda = 450$ nm versus temperature for the sample 6 of 3.0 mg/mL aqueous solution with the addition of NaBr at various concentrations (heating and cooling cycles are symbolized by the filled and unfilled symbols, respectively).
**Figure S16.** Plots of transmittance at $\lambda = 450$ nm *versus* temperature for (A) 0.83 mg/mL aqueous solution of sample 6 with the addition of 0.18 mol/L Na$_2$Cl and (B) 3.0 mg/mL aqueous solution of sample 6.

**Figure S17.** Aggregations diameter *versus* temperature for the aqueous solutions of sample 4 and sample 18 at a concentration of 3.0 mg/mL.