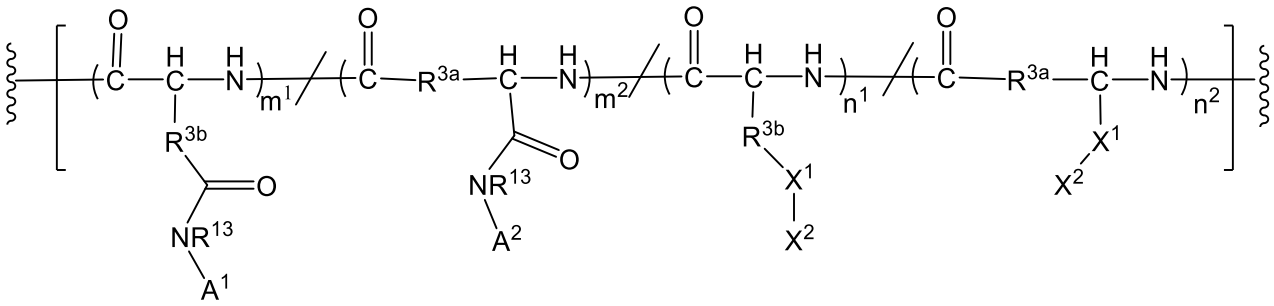
CLAIM(S):

1. A polymer having the structure of Formula 4:



Formula 4

wherein:

each of m^1 and m^2 is an integer from 0 to 1000, provided that the sum of $m^1 + m^2$ is greater than 5;

each of n^1 and n^2 is an integer from 0 to 1000, provided that the sum of $n^1 + n^2$ is greater than 2;

the symbol "/" indicates that the units separated thereby are linked randomly or in any order;

each instance of R^{3a} is independently a methylene or ethylene group;

each instance of R^{3b} is independently a methylene or ethylene group;

each X^1 independently is —C(O)O—, —C(O)NR^{13}—, —C(O)—, —S(O)(O)—, or a bond;

each instance of R^{13} is independently hydrogen, an aryl group, a heterocyclic group, a C_1-C_{12} alkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkyl group, or C_3-C_{12} cycloalkenyl group, any of which can be optionally substituted with one or more substituents;

each instance of X^2 is independently a C_1-C_{12} alkyl or heteroalkyl group, C_3-C_{12} cycloalkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkenyl group, aryl group, heterocyclic group, or combination thereof, any of which can be substituted with one or more substituents;

A^1 and A^2 are each independently a group of formula

$—(CH_2)_{p1}—[NR^2—(CH_2)_{q1}—]_{r1}NR^2{}_2$;

$—(CH_2)_{p2}—N[—(CH_2)_{q2}—NR^2{}_2]_2$;

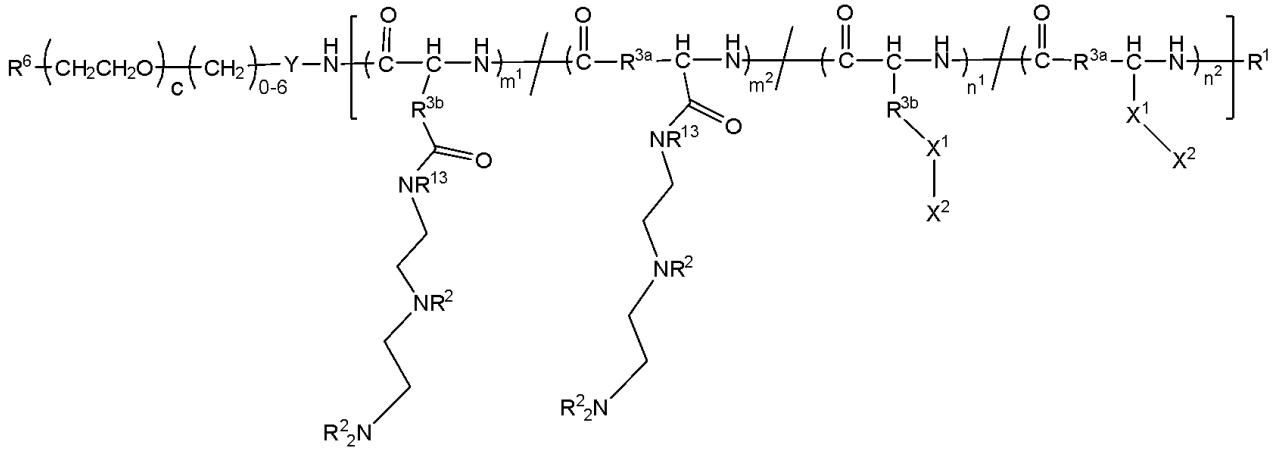
$—(CH_2)_{p3}—N\{[—(CH_2)_{q3}—NR^2{}_2][—(CH_2)_{q4}—NR^2—]_{r2}R^2\}$; or

$—(CH_2)_{p4}—N\{—(CH_2)_{q5}—N[—(CH_2)_{q6}—NR^2{}_2]_2\}_2$,

wherein p1 to p4, q1 to q6, and r1 and r2, are each independently an integer of 1 to 5; and each instance of R^2 is independently hydrogen or a C_1-C_{12} alkyl group, C_2-C_{12} alkenyl group, C_3-C_{12}cycloalkyl group, or C_3-C_{12}cycloalkenyl group, or R^2 is combined with a second R^2 so as to form a heterocyclic group,

and wherein each nitrogen in group A^1 and A^2 containing R^2 substituents is a tertiary amine, with the exception that the terminal amine can be a primary, secondary, or tertiary amine.

2. The polymer of claim 1, having the structure of Formula 1B:



wherein

c is an integer from 0 to 50;

Y is optionally present and is a cleavable linker;

R^1 is hydrogen, an aryl group, a heterocyclic group, a C_1-C_{12} alkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkyl group, or C_3-C_{12} cycloalkenyl group, any of which are optionally substituted with one or more substituents;

each instance of R^2 is independently hydrogen or a C_1-C_{12} alkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkyl group, or C_3-C_{12} cycloalkenyl group; and

R^6 is hydrogen, an amino group, an aryl group, a heterocyclic group, a C_1-C_{12} alkyl group, a C_1-C_{12} heteroalkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkyl group, or C_3-C_{12} cycloalkenyl group, optionally substituted with one or more amines; or a tissue-specific or cell-specific targeting moiety;

and m^1, m^2, n^1, n^2, R^{3a}, R^{3b}, R^{13}, X^1, and X^2 are as defined in claim 1.

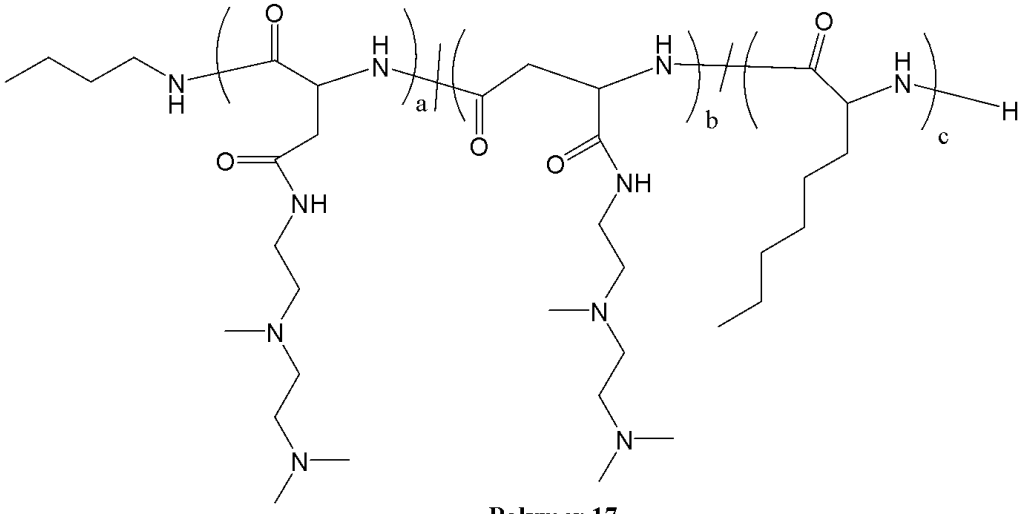
3. The polymer of claim 1 or 2, wherein each instance of R^2 is a C_1-C_3 alkyl.

4. The polymer of any of claims 1-3, wherein each instance of X^2 is independently a C_1-C_{12} alkyl or heteroalkyl group, C_3-C_{12} cycloalkyl group, C_2-C_{12} alkenyl group, C_3-C_{12} cycloalkenyl group, or combination thereof.

5. The polymer of any of claims 1-4, wherein $n^1 + n^2$ is 10-50.

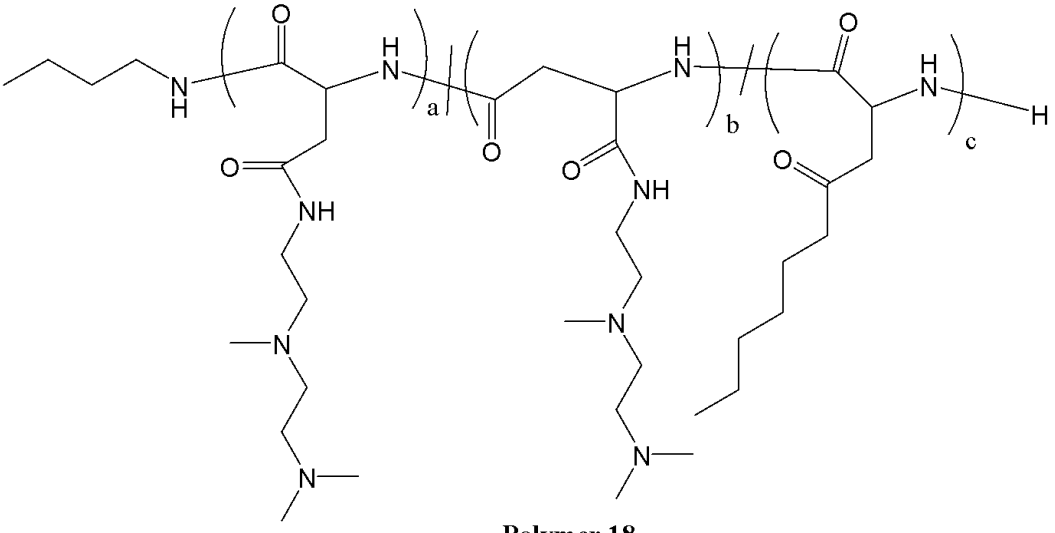
6. The polymer of any of claims 1-5, wherein $m^1 + m^2$ is 20-50.

7. The polymer of claim 1, having the formula:



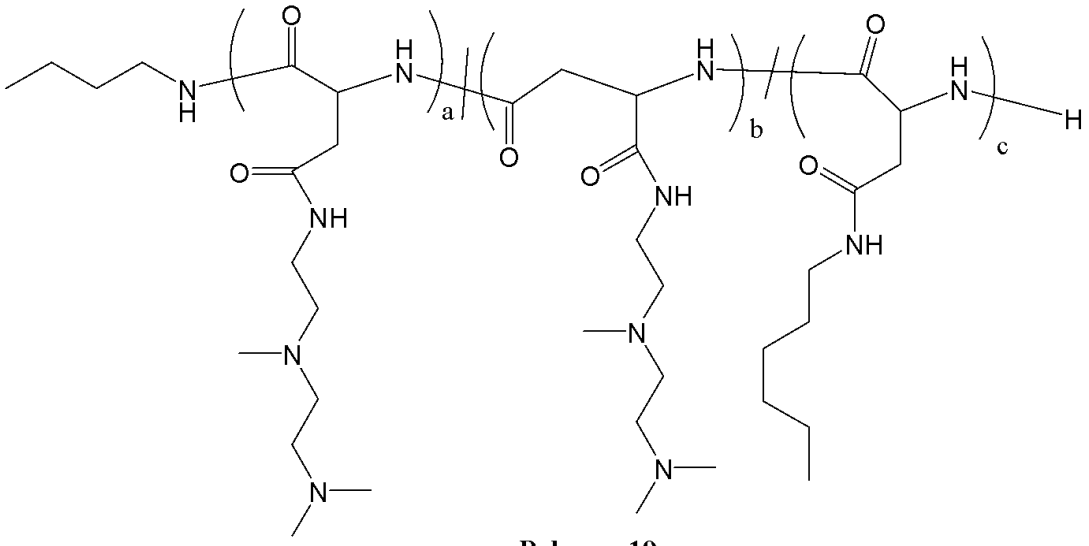
Polymer 17

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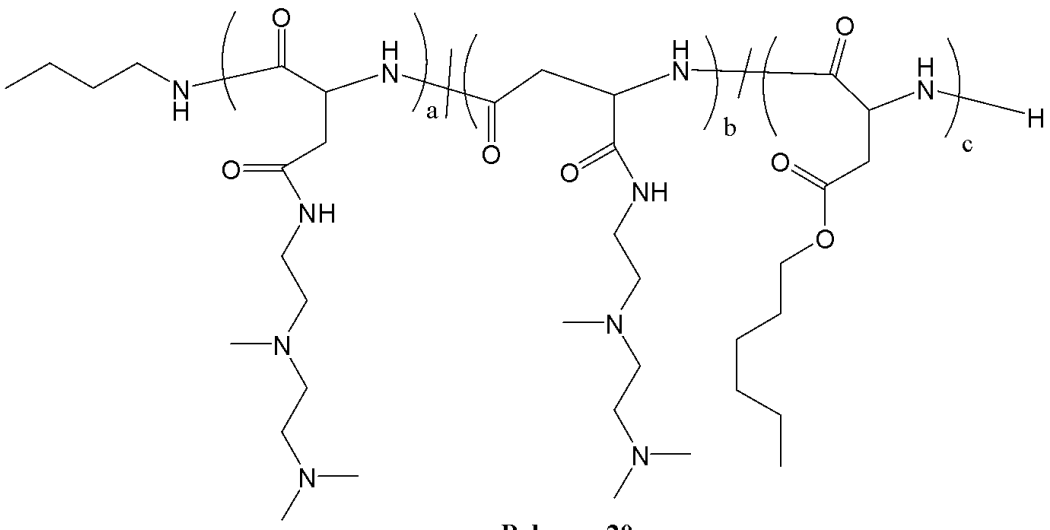
Polymer 18

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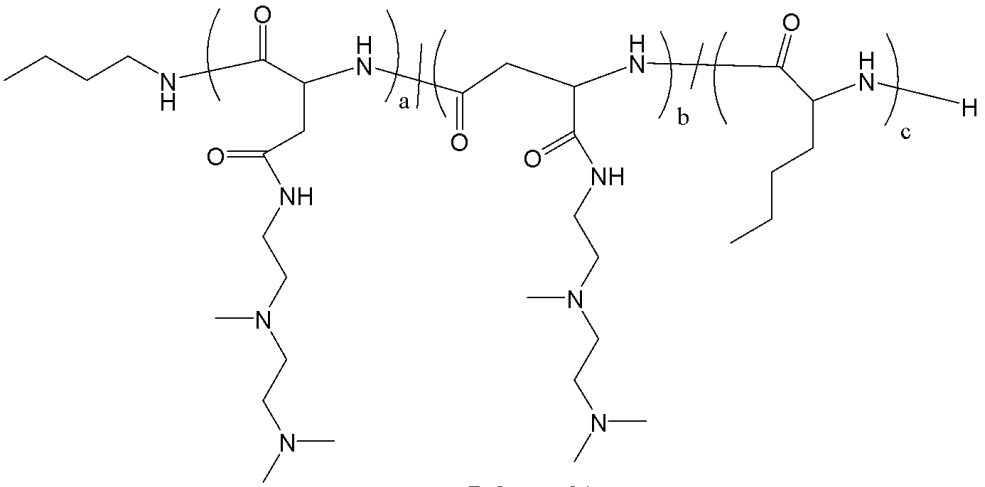
Polymer 19

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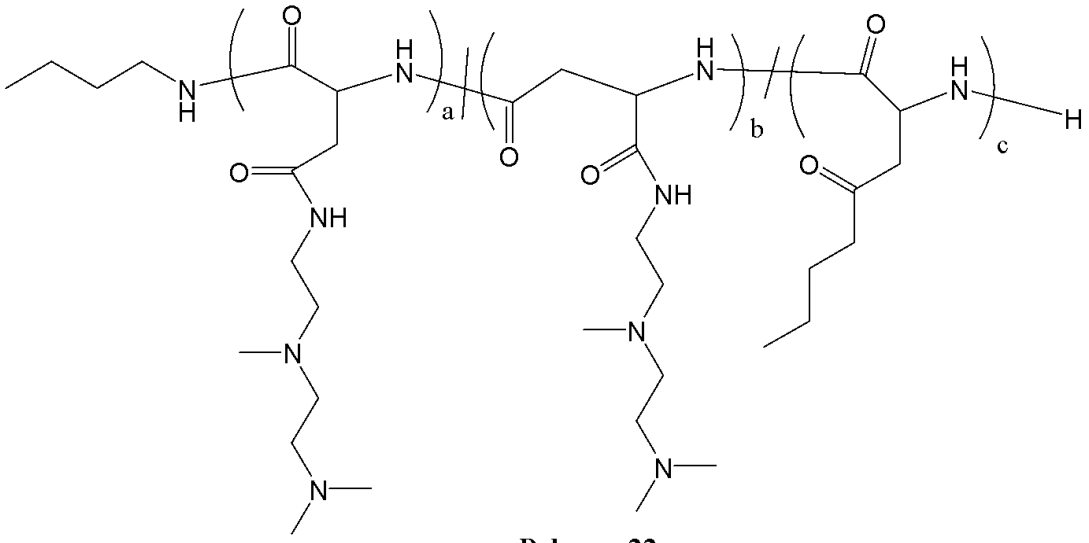
Polymer 20

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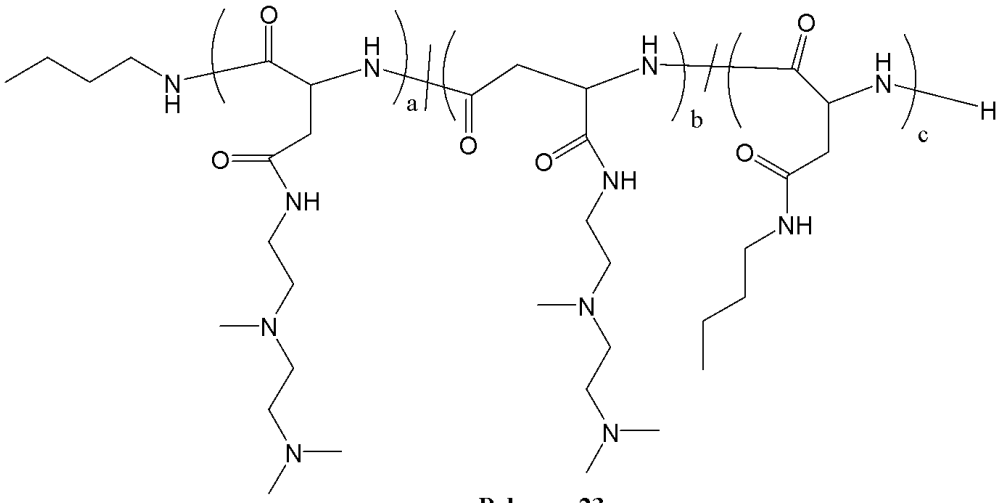
Polymer 21

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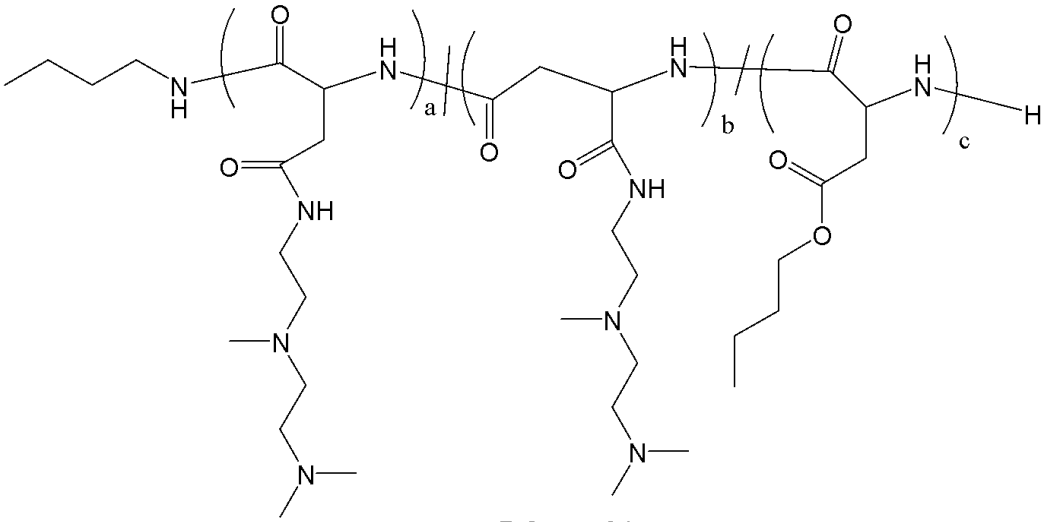
Polymer 22

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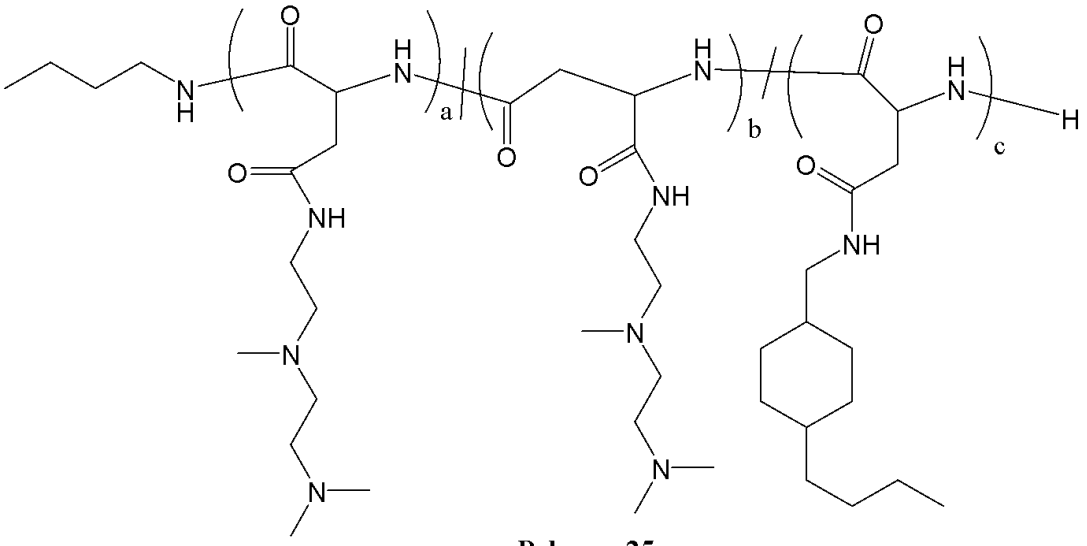
Polymer 23

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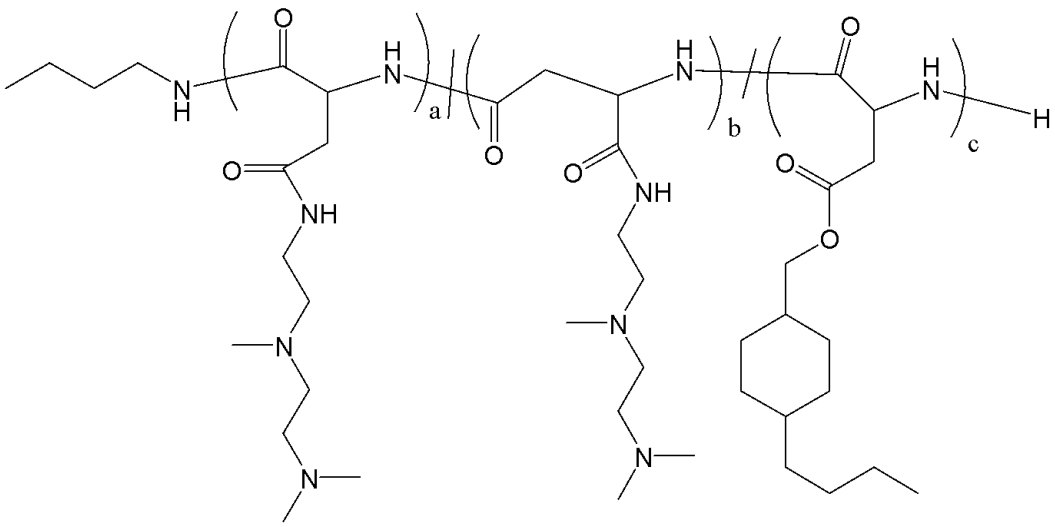
Polymer 24

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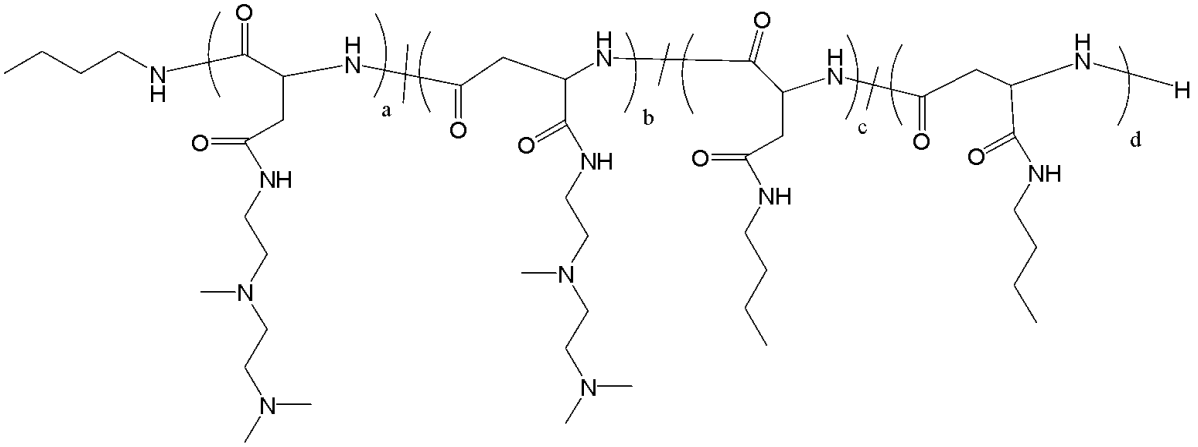
Polymer 25

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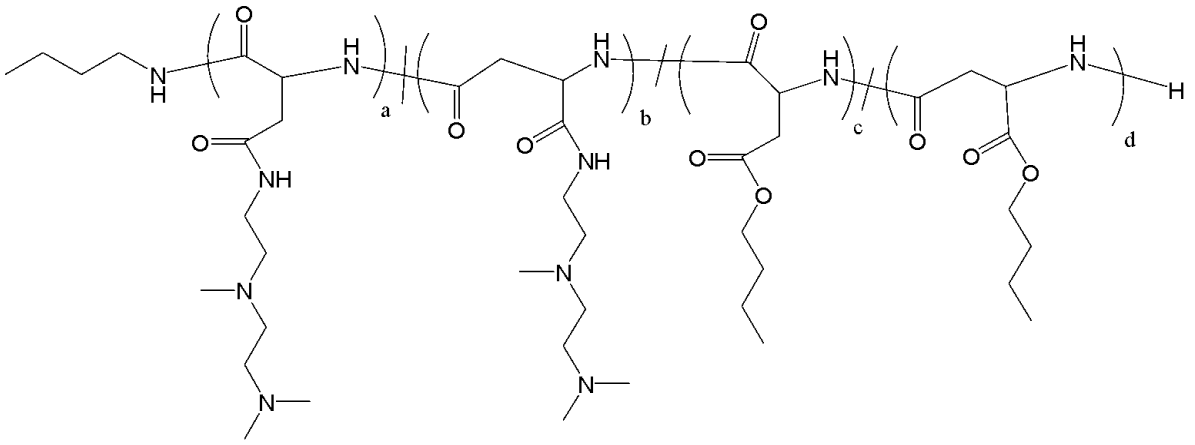
Polymer 26

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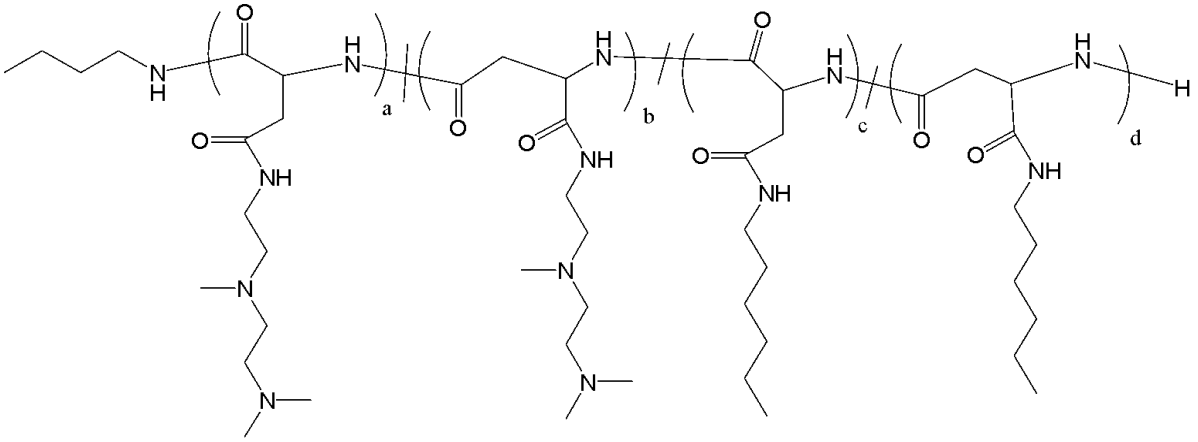
Polymer 27

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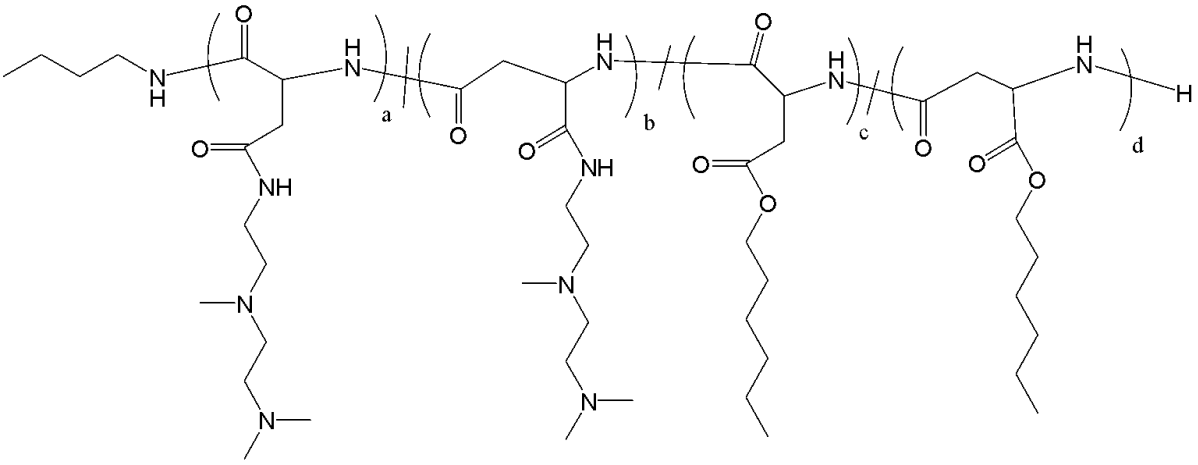
Polymer 28

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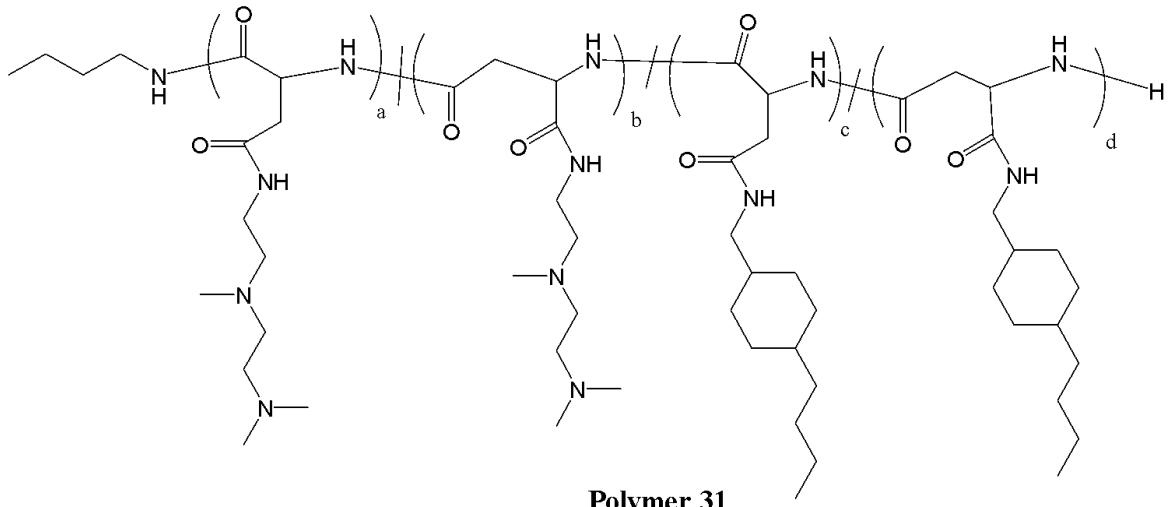
Polymer 29

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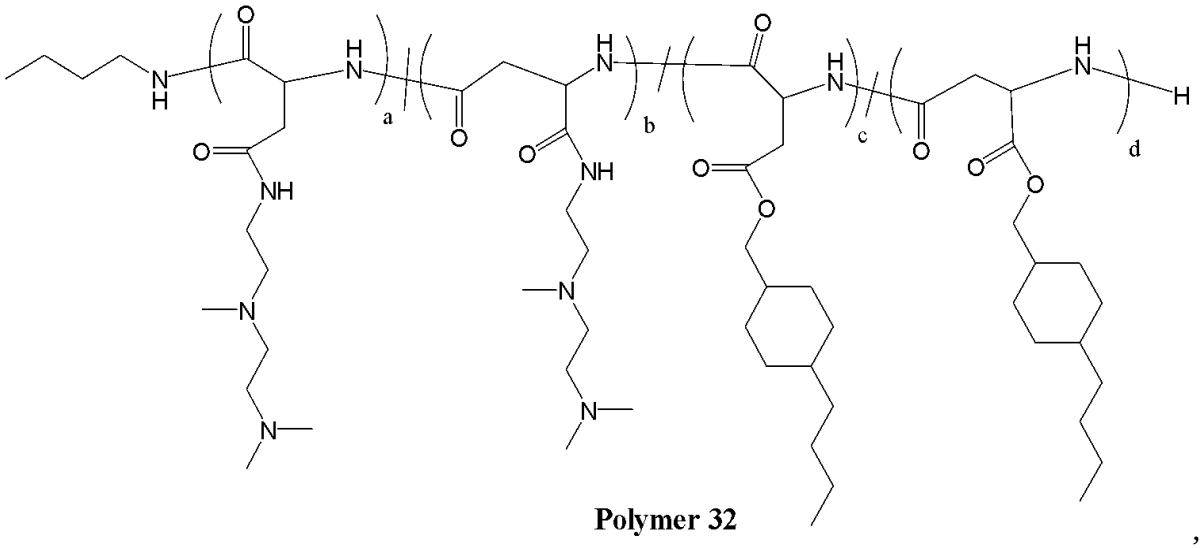
Polymer 30

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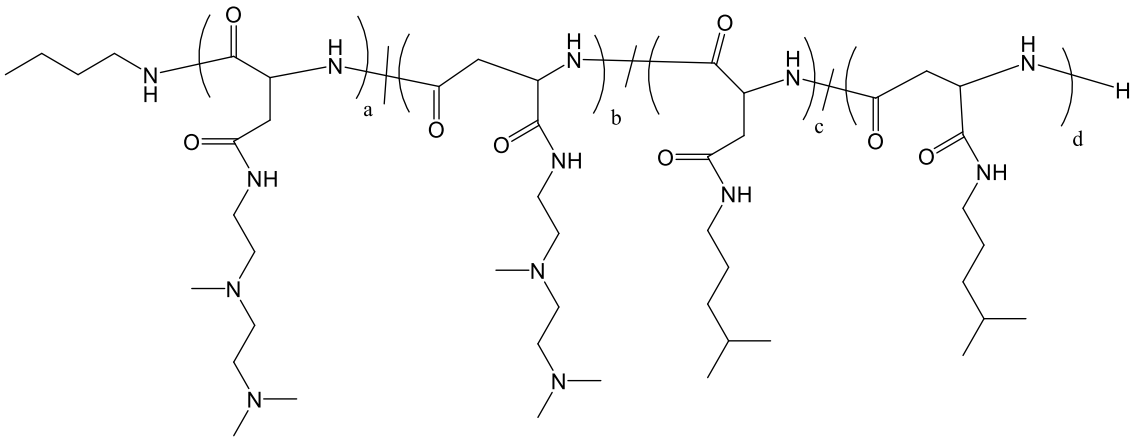
Polymer 31

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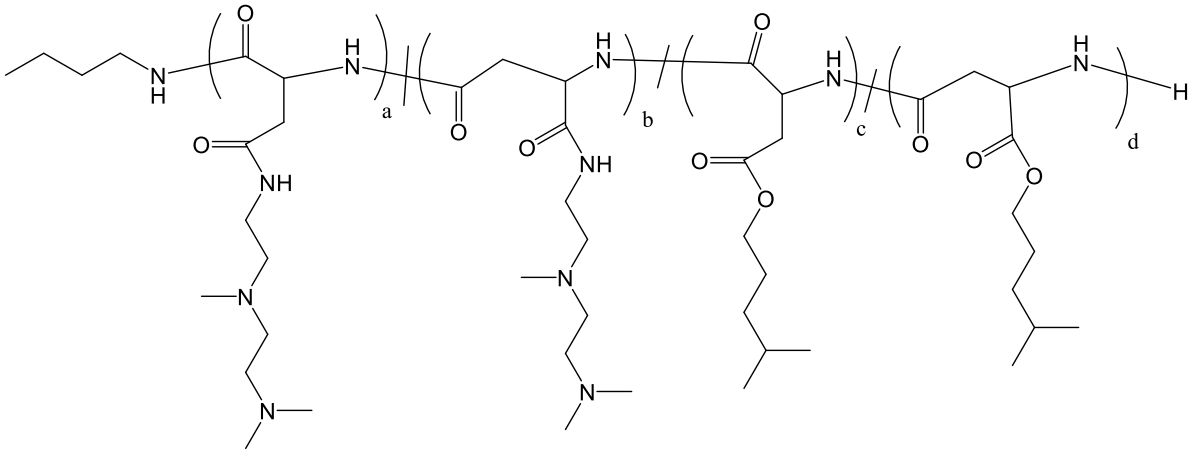
Polymer 32

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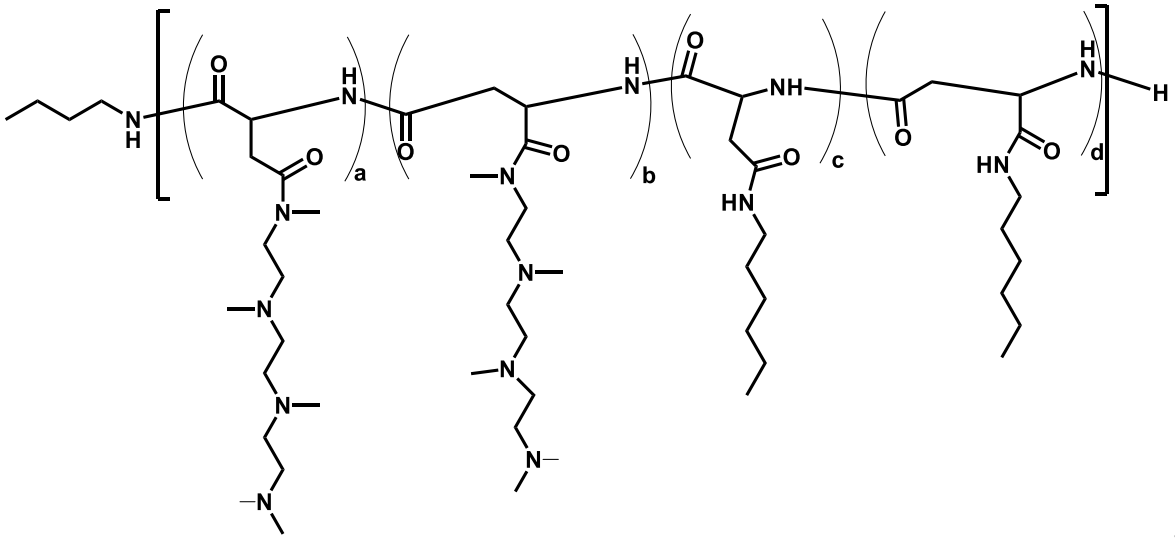
Polymer 35

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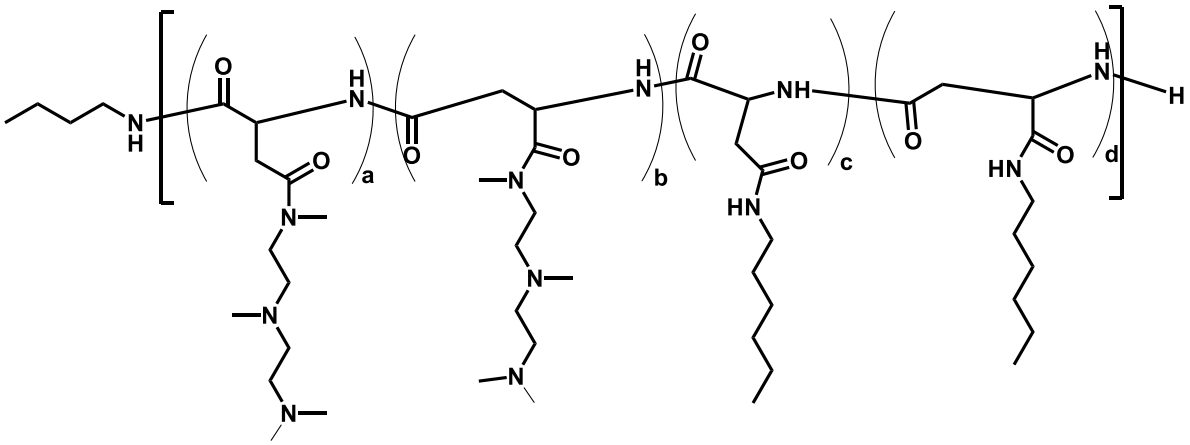
Polymer 36

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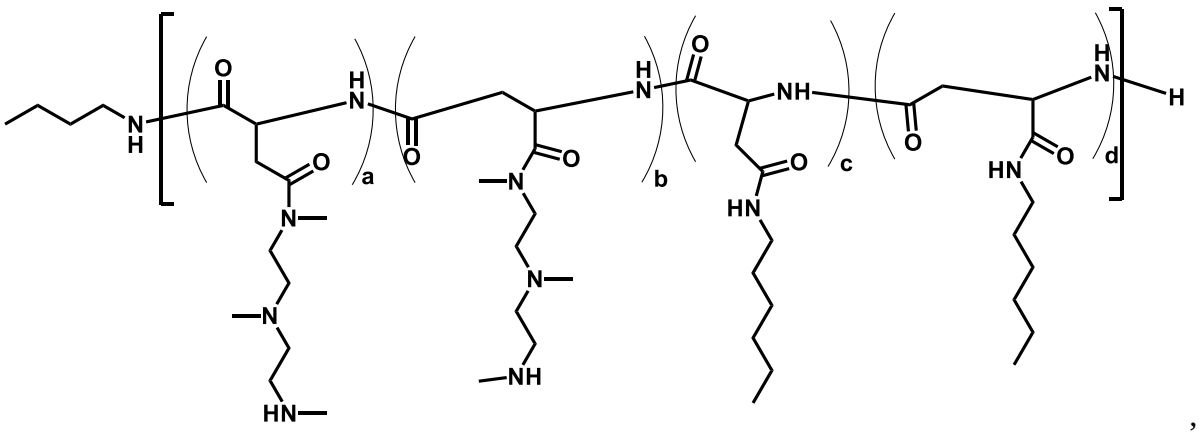
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Polymer 38

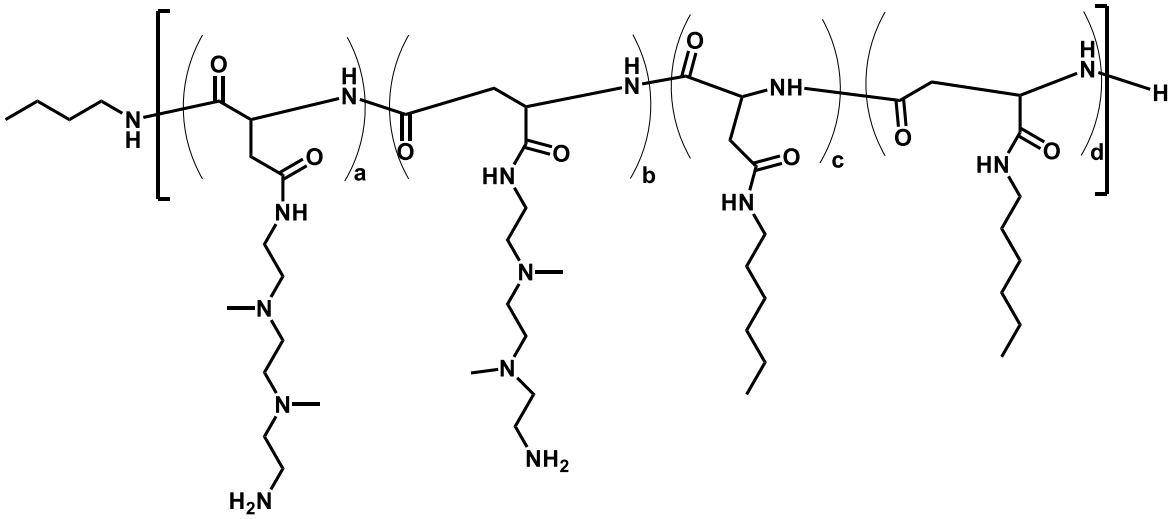


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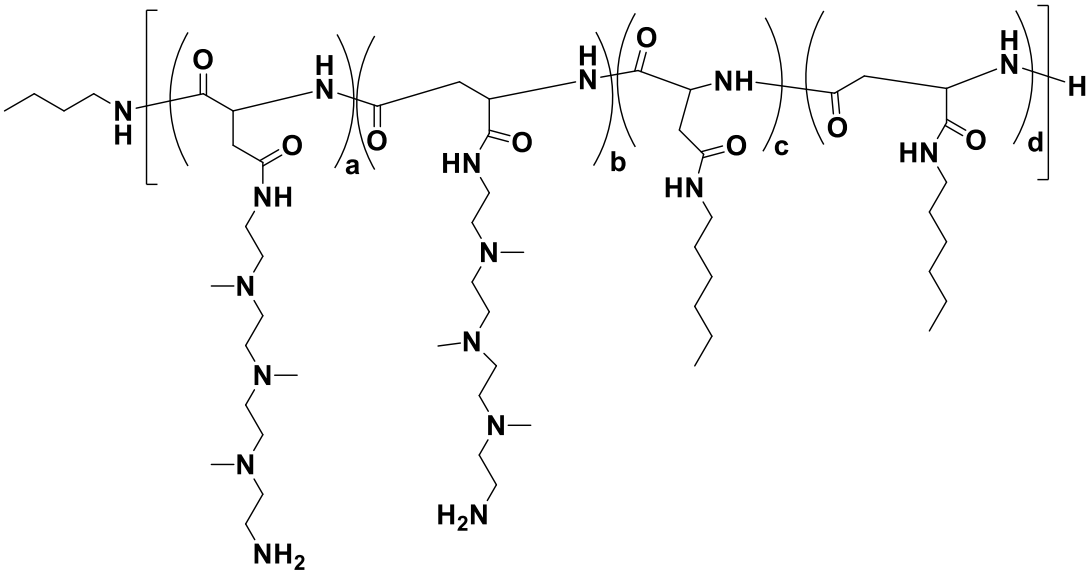
Polymer 39



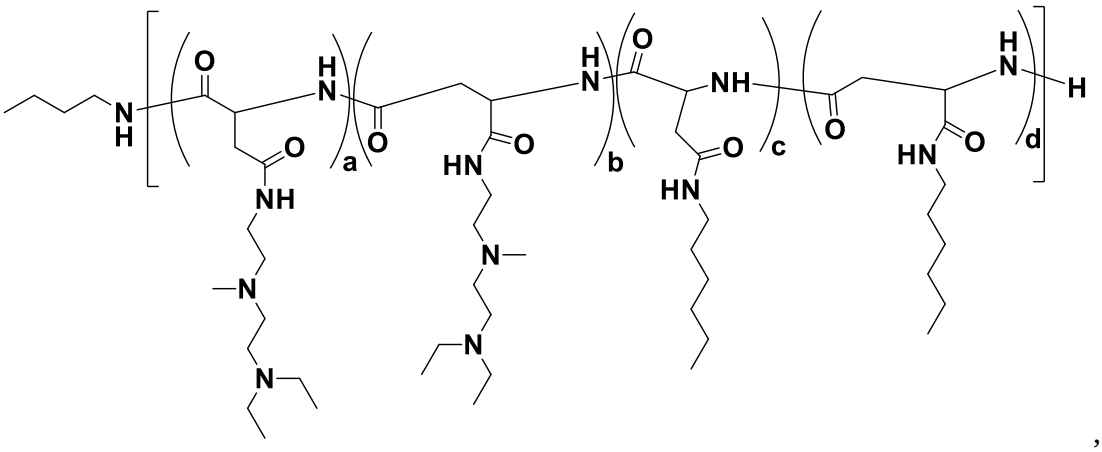
Polymer 40



Polymer 41



Polymer 42



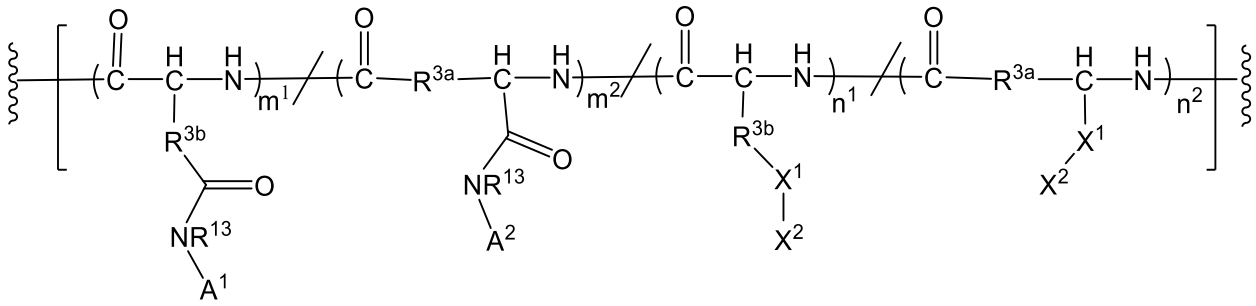
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Polymer 43

wherein (a+b) is from about 5 to about 65, and (c+d) is from about 2 to about 60.

8. The polymer of any of claims 1-7, wherein the polymer is a cationic polymer.

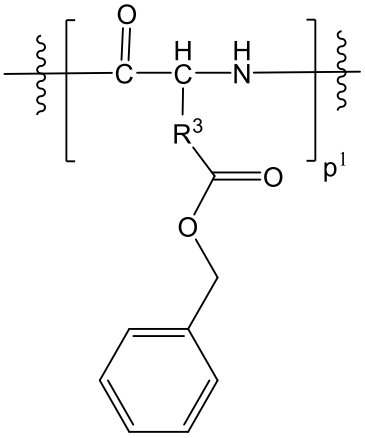
9. A method of preparing a polymer of Formula 4 according to claim 1:



Formula 4

the method comprising:

(I) reacting a polymer of Formula 2:

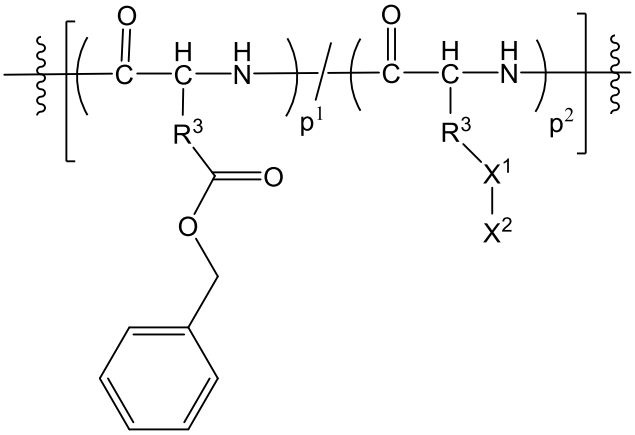


Formula 2

with (a) a compound of the formula $HNR^{13}A^1$ and/or $HNR^{13}A^2$; and (b) a compound of formula H_2NX^2 or HOX^2, simultaneously or in any sequential order;

or

(II) reacting a polymer of Formula 3



Formula 3

with a compound of the formula $HNR^{13}A^1$ and/or $HNR^{13}A^2$;

wherein,

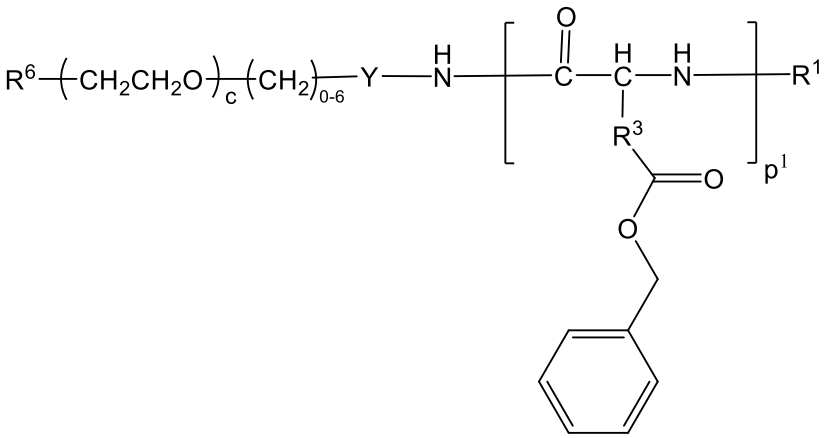
p^1 is an integer from 1 to 2000;

p^2 is an integer from 1 to 2000;

each R^3 is independently a methylene or ethylene group;

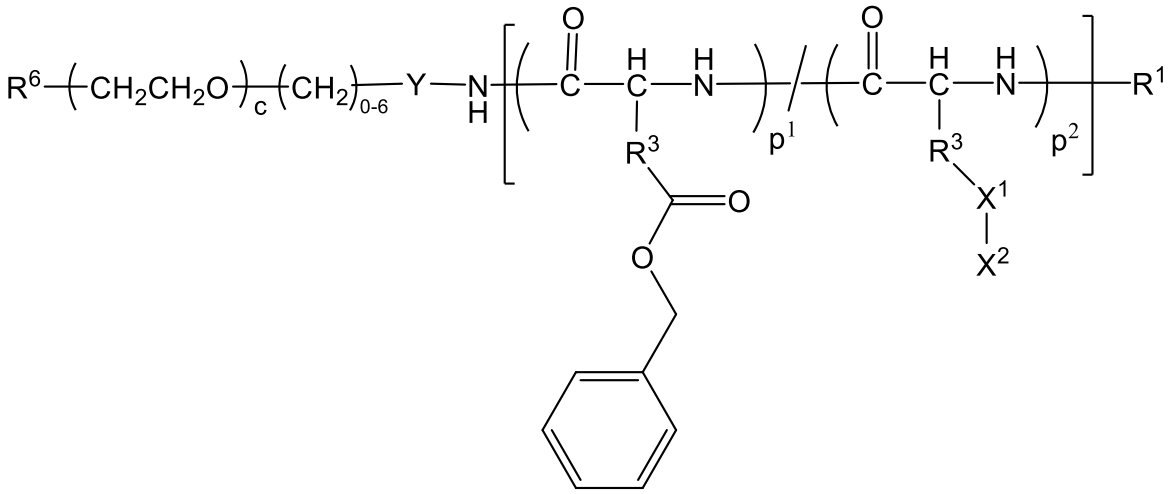
and m^1, m^2, n^1, n^2, R^{3a} , R^{3b} , R^{13}, X^1, X^2, A^1, and A^2 are as defined in claim 1.

10. The method of claim 9, wherein the polymer comprising the structure of Formula 2 or Formula 3 is a polymer of Formula 2A or Formula 3A, respectively:



Formula 2A

or



Formula 3A

;

wherein,

p^1 is an integer from 1 to 2000;

p^2 is an integer from 1 to 2000;

each R^3 is independently a methylene or ethylene group;

each X^1 independently is —C(O)O—, —C(O)NR^{13}—, —C(O)—, —S(O)(O)—, or a bond;

each instance of X^2 is independently a C_1-C_{12} alkyl group, cycloalkyl group, alkenyl group, cycloalkenyl group, aryl group, heteroalkyl group, heterocyclic group, or combination thereof optionally comprising one or more primary, secondary, or tertiary amines; any of which can be substituted with one or more substituents;

c is an integer from 0 to 50;

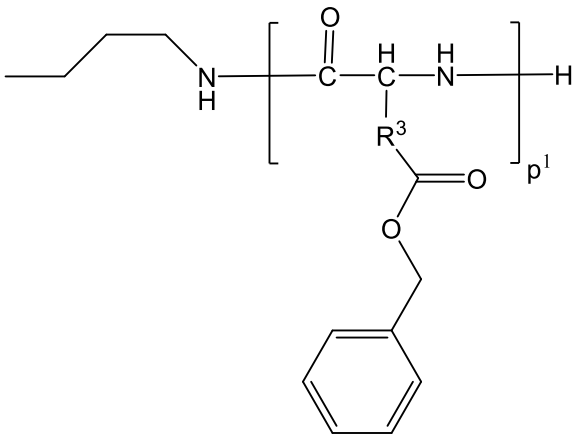
Y is optionally present and is a cleavable linker;

R^1 is hydrogen, an aryl group, a heterocyclic group, a C_1-C_{12} alkyl group, alkenyl group, cycloalkyl group, or cycloalkenyl group, or a C_1-C_{12} linear or branched alkyl group optionally substituted with one or more substituents; and

R^6 is hydrogen, an amino group, an aryl group, a heterocyclic group, a C_1-C_{12} alkyl group, a C_1-C_{12} heteroalkyl group, alkenyl group, cycloalkyl group, or cycloalkenyl group, a C_1-C_{12} linear or branched alkyl group optionally substituted with one or more amines; or a tissue-specific or cell-specific targeting moiety;

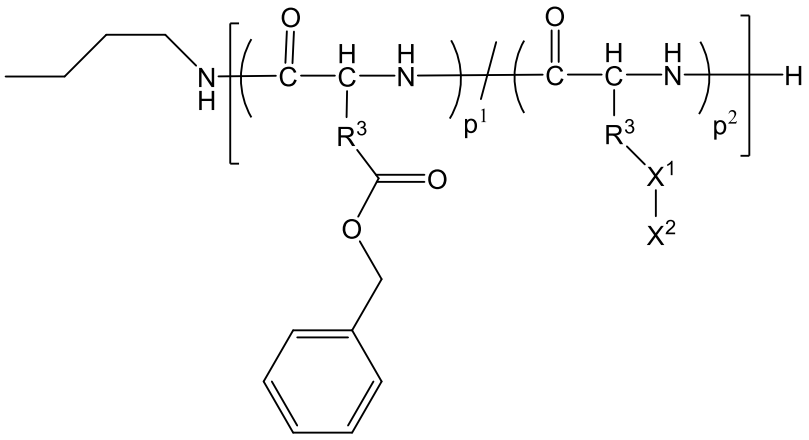
and p^1, p^2, R^3, X^1, and X^2 are as defined in claim 9.

11. The method of claim 9, wherein the polymer comprising the structure of Formula 2 or Formula 3 is a polymer of Formula 2B or Formula 3B, respectively:



Formula 2B

or



Formula 3B

;

wherein,

and p^1, p^2, R^3, X^1, and X^2 are as defined in claim 9.

12. The method of claim 9 comprising combining a compound of Formula 2 with (a) a compound of $HNR^{13}A^1$ and/or $HNR^{13}A^2$, and (b) compound of formula H_2NX^2 or HOX^2, wherein (a) and (b) are present in a molar ratio of about 1:10 to about 1:150, optionally about 1:40 to about 1:150, or about 1:80 to about 1:150.

13. A composition comprising a polymer of any one of claims 1-8 and a nucleic acid and/or polypeptide.

14. The composition of claim 13, wherein the composition comprises a guide nucleic acid and/or donor nucleic acid.

15. The composition of claim 13 or 14, wherein the composition comprises an endonuclease.

16. The composition of claim 15, wherein the composition comprises an RNA-guided endonuclease or nucleic acid encoding same.

17. The composition of claim 16, wherein the RNA-guided endonuclease is Cas9, Cpf1, or a combination thereof.

18. The composition of any one of claims 13-17, wherein the composition comprises a DNA recombinase, zinc finger nuclease, or transcription activator-like nuclease.

19. The composition of claims 13-17, wherein the composition comprises a nucleic acid.

20. The composition of claim 19, wherein the nucleic acid is an siRNA, microRNA, interfering RNA, dsRNA, mRNA, DNA vector, ribozyme, antisense polynucleotide, or DNA expression cassette encoding an siRNA, microRNA, dsRNA, ribozymes or antisense nucleic acid.

21. The composition of claim 19, wherein the composition comprises an siRNA.

22. The composition of any one of claims 13-21, wherein the composition comprises a nanoparticle comprising the polymer of any of claims 1-20 and the nucleic acid or polypeptide.

23. The composition of any one of claims 13-22, wherein the composition comprises a second polymer that comprises polyethylene oxide.

24. A method of delivering a nucleic acid and/or polypeptide to a cell *in vitro*, the method comprising administering the composition of any one of claims 13-23 to the cell.

25. Use of a composition of any of claims 13-23 for preparing a medicament for delivering a nucleic acid and/or polypeptide to a cell in a subject.