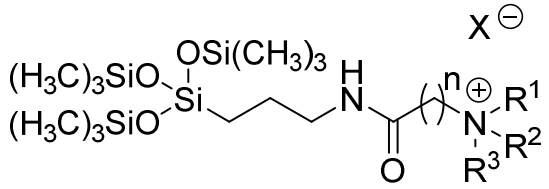
CLAIMS

1. A compound of Formula I:



Formula I

wherein R^1 and R^2 are the same or different, and comprise at least one group selected from the group consisting of C_1-C_6 alkyl, optionally the C_1-C_6 alkyl may include one or more of oxygen, nitrogen, or sulfur atoms or groups that include at least one of these atoms, and the alkyl chain may be optionally substituted with one or more substituents selected from the group consisting of hydroxyl, amino, amido, sulfonyl, sulfonate, carbonyl, carboxyl, and carboxylate;

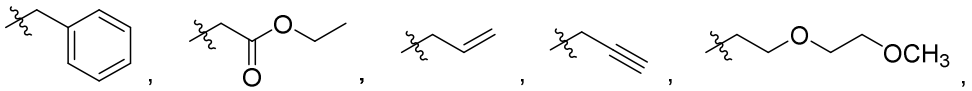
R^3 is selected from the group consisting of alkenyl, alkynyl, ester, alcohol, aryl alkyl, alkoxy alkyl ether, alkyl phosphate, C_3-C_8 carboxylic acid, C_1-C_{10} alkyl benzoic acid, and a C_1-C_6 linker attached to a second molecule of Formula I, wherein the second molecule is the same or different;

n is an integer from 3 to 12; and

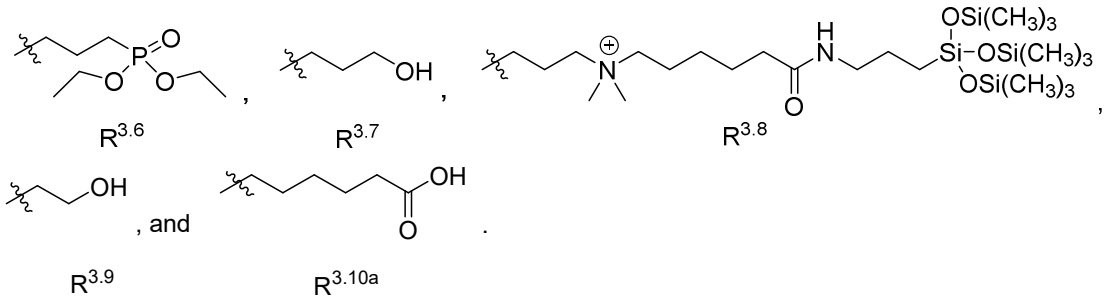
X is selected from the group consisting of chloride, bromide, and iodide.

2. The compound of claim 1, wherein R^3 is selected from the group consisting of C_2-C_{10} alkenyl, C_2-C_{10} alkynyl, C_2-C_{12} ester, C_1-C_{10} hydroxyl, benzyl, C_2-C_{12} alkoxy alkyl ether, alkyl phosphate, C_3-C_8 carboxylic acid, C_1-C_{10} alkyl benzoic acid, and a three-carbon linker attached to a second molecule of Formula I, wherein the second molecule is the same as the first molecule.

3. The compound of either claim 1 or claim 2, wherein R^3 is selected from the formulas consisting of:



$R^{3.1}$, $R^{3.2}$, $R^{3.3}$, $R^{3.4}$, $R^{3.5}$,

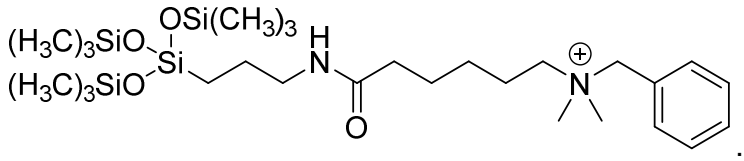


$R^{3.6}$, $R^{3.7}$, $R^{3.8}$, $R^{3.9}$, and $R^{3.10a}$.

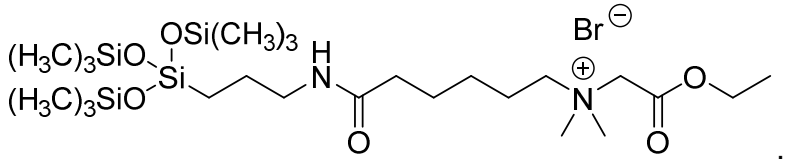
4. The compound of any one of claims 1 to 3, wherein R^1 and R^2 are methyl.

5. The compound of any one of claims 1 to 4, wherein n is 5.

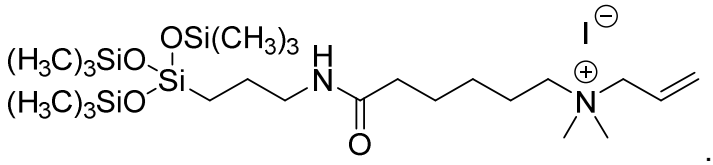
6. The compound of any one of claims 1 to 5, wherein the compound is N-benzyl-6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxohexan-1-aminium bromide, having the following formula:



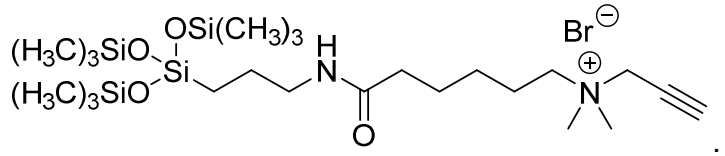
7. The compound of any one of claims 1 to 5, wherein the compound is N-(2-ethoxy-2-oxoethyl)-6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxohexan-1-aminium bromide, having the following formula:



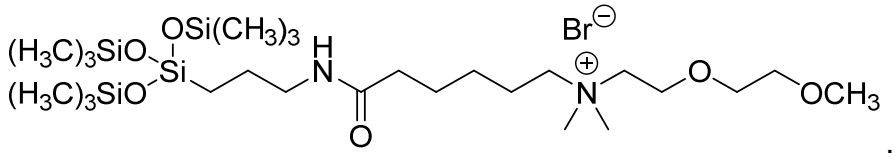
8. The compound of any one of claims 1 to 5, wherein the compound is N-allyl-6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxohexan-1-aminium iodide, having the following formula:



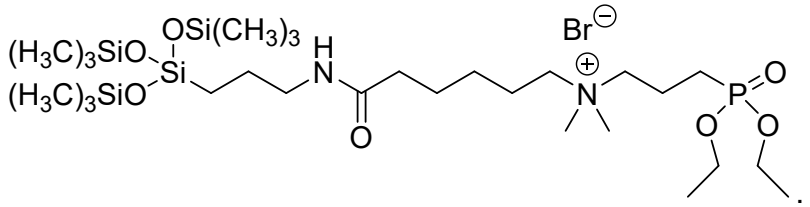
9. The compound of any one of claims 1 to 5, wherein the compound is 6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxo-N-(prop-2-yn-1-yl)hexan-1-aminium bromide, having the following formula:



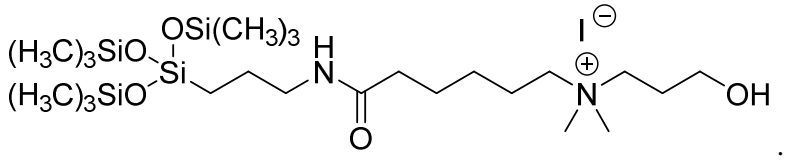
10. The compound of any one of claims 1 to 5, wherein the compound is 6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N-(2-(2-methoxyethoxy)ethyl)-N,N-dimethyl-6-oxohexan-1-aminium bromide, having the following formula:



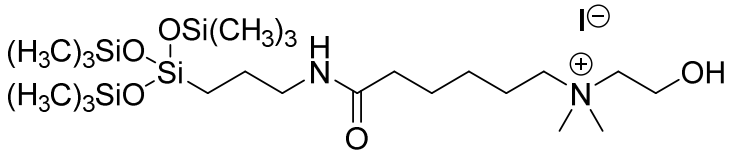
11. The compound of any one of claims 1 to 5, wherein the compound is N-(3-(diethoxyphosphoryl)propyl)-6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxohexan-1-aminium bromide, having the following formula:



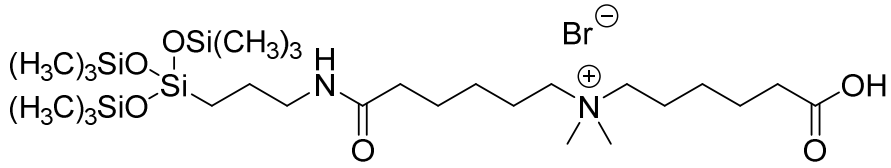
12. The compound of any one of claims 1 to 5, wherein the compound is 6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N-(3-hydroxypropyl)-N,N-dimethyl-6-oxohexan-1-aminium iodide, having the following formula:



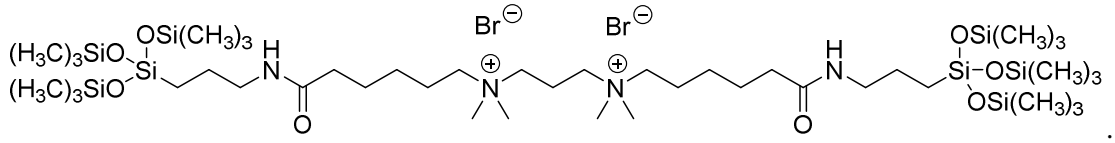
13. The compound of any one of claims 1 to 5, wherein the compound is 6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N-(2-hydroxyethyl)-N,N-dimethyl-6-oxohexan-1-aminium iodide, having the following formula:



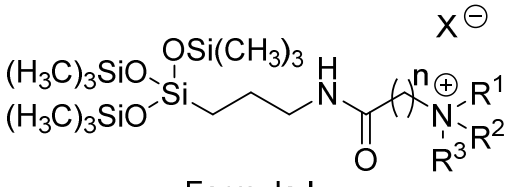
14. The compound of any one of claims 1 to 5, wherein the compound is N-(5-carboxypentyl)-6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-N,N-dimethyl-6-oxohexan-1-aminium bromide, having the following formula:



15. The compound of any one of claims 1 to 5, wherein the compound is N^1,N^3-bis(6-((3-(1,1,1,5,5,5-hexamethyl-3-((trimethylsilyl)oxy)trisiloxan-3-yl)propyl)amino)-6-oxohexyl)-N^1,N^1,N^3,N^3-tetramethylpropane-1,3-diaminium dibromide, having the formula:



16. A method of synthesizing a compound of Formula I



Formula I

wherein R^1 and R^2 are the same or different, and comprise at least one group selected from the group consisting of C_1-C_6 alkyl, optionally the C_1-C_6 alkyl may include one or more of oxygen, nitrogen, or sulfur atoms or groups that include at least one of these atoms, and the alkyl chain may be optionally substituted with one

or more substituents selected from the group consisting of hydroxyl, amino, amido, sulfonyl, sulfonate, carbonyl, carboxyl, and carboxylate;

R^3 is selected from the group consisting of alkenyl, alkynyl, ester, alcohol, aryl alkyl, alkoxy alkyl ether, alkyl phosphate, C_3-C_8 carboxylic acid, C_1-C_{10} alkyl benzoic acid, and a C_1-C_6 linker attached to a second molecule of Formula I, wherein the second molecule is the same or different;

n is an integer from 3 to 12; and

X is selected from the group consisting of chloride, bromide, and iodide, the method comprising:

a ring opening step to open lactam ring to provide an amino acid having an N-terminus and a C-terminus;

a first alkylation step, to alkylate the N-terminus to provide a tertiary amine;

a coupling step, to react the C-terminus with 3-aminopropyltris(trimethylsiloxy)silane to provide siloxane derivative; and

a second alkylation step, to alkylate the N-terminus to provide a quaternary amine of Formula I.

17. The method of claim 16, wherein the lactam is caprolactam.

18. The method of either claim 16 or claim 17, wherein in the first alkylation step, the tertiary amine is 6-(dimethylamino)hexanoic acid.

19. The method of any one of claims 16 to 18, wherein in the second alkylation step, the N-terminus is alkylated with an alkylating agent selected from the group consisting of benzyl bromide, ethyl bromoacetate, allyl iodide, propargyl bromide, 1-bromo-2-(2-methoxyethoxy)ethane, bromo phosphonate, 3-iodopropanol, 3-bromopropanol, 2-iodoethanol, 2-bromoethanol, 6-bromohexanoic acid, and 1,3-dibromopropane.