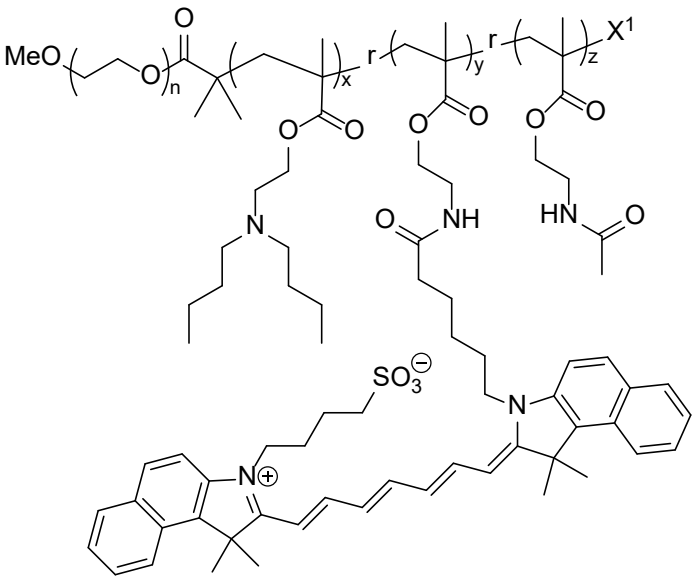
CLAIMS

1. A block copolymer having the structure of Formula (II), or a pharmaceutically acceptable salt, solvate, hydrate, or isotopic variant thereof:



Formula (II),

wherein:

X^1 is a halogen, -OH, or –C(O)OH;

r is independently a bond connecting carbon atoms of the units/segments, or an alkyl group $-(CH_2)_n-$ wherein n is 1 to 10;

n is 90-140;

x is 50-200;

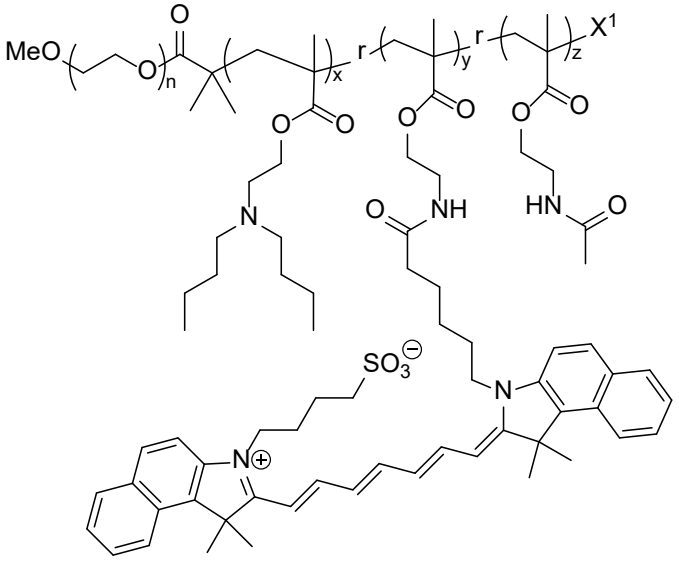
y is 1-3; and

z is 1-3.

2. The block copolymer of claim 1, wherein X^1 is –Br.
3. The block copolymer of any one of claims 1-2, wherein n is 100-120 and x is 60–150.
4. A composition or micelle comprising of one or more block copolymers of any one of claims 1-3.
5. A pH responsive composition comprising the composition or micelle of claim 4, wherein the micelle has a pH transition point and an emission spectrum, and the pH transition point is between 4.8-5.5 and the emission spectrum is between 700-900 nm.
6. The pH responsive composition of claim 5, wherein the composition has a pH transition range ($\Delta pH_{10\text{-}90\%}$) of less than 1 pH unit and the composition has a fluorescence activation ratio of greater than 25.
7. An imaging agent comprising one or more block copolymers of any one of claims 1-3, wherein the imaging agent comprises poly(ethyleneoxide)-b-poly(dibutylaminoethyl

methacrylate-r-aminoethylmethylacrylate hydrochloride) copolymer indocyanine green and acetic acid conjugate.

8. A pharmaceutical composition comprising a micelle, wherein the micelle comprises 1) one or more block copolymers having the structure of Formula (II), or a pharmaceutically acceptable salt, solvate, or hydrate:



Formula (II),

wherein:

X^1 is a halogen, -OH, or –C(O)OH;

r is independently a bond connecting carbon atoms of the units/segments, or an alkyl group $-(CH_2)_n-$ wherein n is 1 to 10;

n is 90-140;

x is 50-200;

y is 1-3;

z is 1-3; and

2) a stabilizing agent.

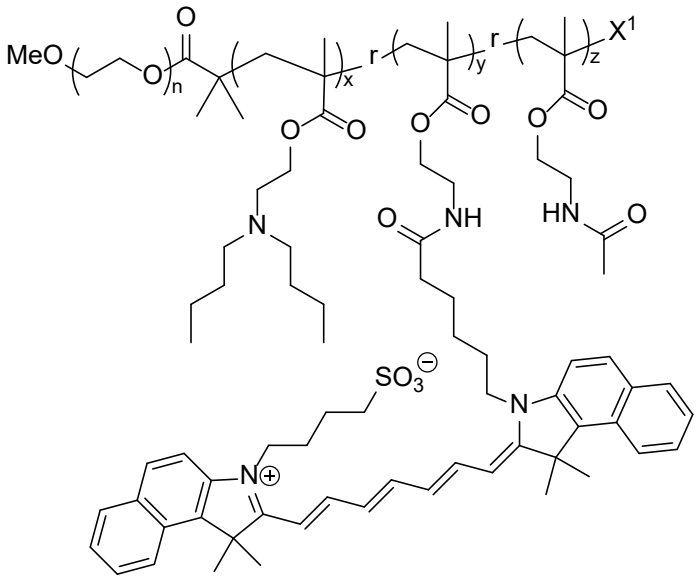
9. The pharmaceutical composition of claim 8, wherein the stabilizing agent is a cryoprotectant, a sugar, a sugar derivative, a detergent, or a salt.

10. The pharmaceutical composition of claim 9, wherein the stabilizing agent is trehalose.

11. The pharmaceutical composition of any one of claims 8-10, comprising from 0.5% to 25% w/v of the stabilizing agent.

12. The pharmaceutical composition of any one of claims 8-11, further comprising a liquid carrier, wherein the liquid carrier is sterile water, normal saline, half normal saline, 5% dextrose in water (D5W), ringers lactate solution, or a combination thereof.

13. A pharmaceutical composition, comprising 1) at least about 3 mg/mL of a block copolymer having the structure of Formula (II), or a pharmaceutically acceptable salt, solvate, or hydrate thereof:



Formula (II),

wherein:

X^1 is –Br;

r is independently a bond connecting carbon atoms of the units/segments, or an alkyl group $-(CH_2)_n-$ wherein n is 1 to 10;

n is 90-140;

x is 60-150;

y is 1-3;

z is 1-3; and

2) about 10% trehalose w/v in water.

14. A method of imaging the pH of an intracellular or extracellular environment, the method comprising:

a) contacting the intracellular or extracellular environment with a block copolymer of any one of claims 1-3 or a pharmaceutical composition of any one of claims 8-13; and

b) detecting one or more optical signals from the intracellular or extracellular environment, wherein a detected optical signal indicates that the micelle comprising one or more block copolymers of Formula (II) has reached its pH transition point and disassociated.

15. The method of claim 14, wherein the pharmaceutical composition is to be administered to the patient in need prior to a surgery.

16. Use of a block copolymer of any one of claims 1-3 or a pharmaceutical composition of any one of claims 8-13 in the preparation of a medicament for treatment in a method of resecting a tumor in a patient in need thereof, comprising:

    a) detecting one or more optical signals from the tumor or a sample thereof from the patient administered with an effective dose of a block copolymer of any one of claims 1-3 or a pharmaceutical composition of any one of claims 8-13, wherein a detected optical signal(s) indicates the presence of the tumor; and

    b) wherein the tumor is to be resected via a surgery.

17. The use of claim 16, wherein the tumor is breast cancer, head and neck squamous cell carcinoma (NHSCC), lung cancer, ovarian cancer, prostate cancer, bladder cancer, urethral cancer, esophageal cancer, brain cancer, pancreatic cancer, skin cancer, melanoma, sarcoma, pleural metastasis, kidney cancer, lymph node cancer, cervical cancer, or colorectal cancer.

18. The use of any one of claims 16-17, wherein the copolymer or the pharmaceutical composition is to be administered as an injection or an infusion.

19. The use of any one of claims 16-18, wherein the pharmaceutical composition is to be administered at least 1 hour prior to a surgery.

20. Use of the block copolymer of any one of claims 1-3 or the pharmaceutical composition of any one of claims 8-13 in the preparation of a medicament for treating cancer, comprising:

    a) detecting one or more optical signals in a cancer patient in need thereof to be administered with an effective dose of a block copolymer of any one of clams 1-3 or a pharmaceutical composition of any one of claims 8-13, wherein a detected optical signal indicates the presence of a cancerous tumor; and

    b) wherein the cancerous tumor is to be removed, thereby treating the cancer.