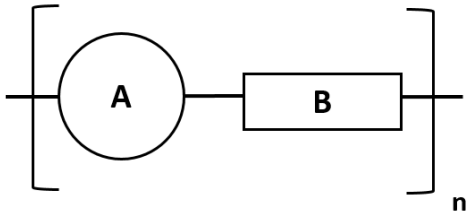
CLAIMS

1. A flame retardant synergist comprising:

a repeating unit comprising:

a backbone represented by a formula of:



wherein moiety A is derived from a substituted triazine having at least two amino groups;

wherein moiety B is derived from a dialdehyde having a terminal aldehyde;

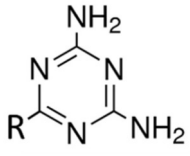
wherein moiety A and moiety B are bonded via a -C-N- linkage formed from having one of the at least two amino groups reacted with the terminal aldehyde;

wherein n ranges from 5 to 1000;

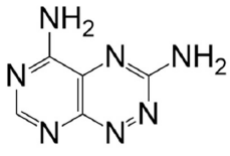
and

one or more side units extending from the backbone, wherein the one or more side units are derived from 9,10-dihydro-9-oxa-10-phosphaphenanthrene 10-oxide or a derivative thereof,

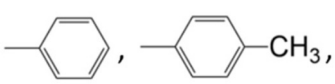
wherein the substituted triazine is:

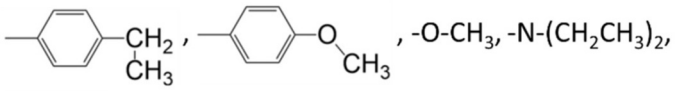


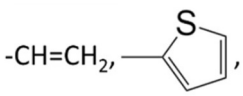
or



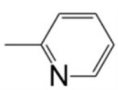
wherein R is selected from the group consisting of hydrogen, $C_{1\text{-}6}$ alkyl,







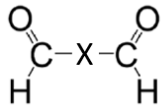
and

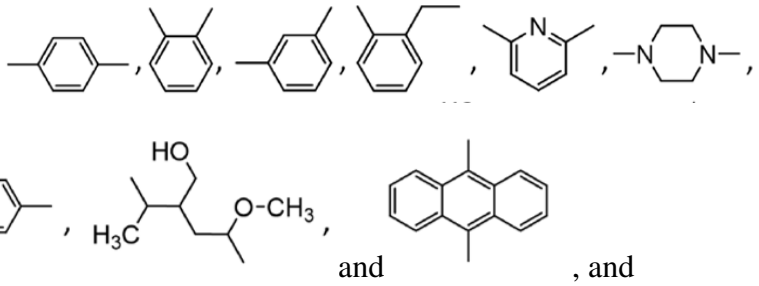


,

and

wherein the dialdehyde is:



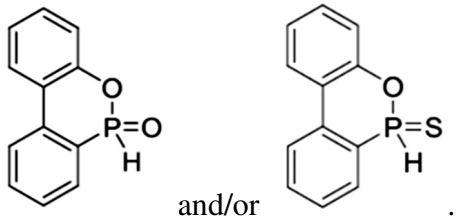
wherein X is selected from the group consisting of a bond, -$(CH_2)_m$-, -$(CH_2)_2$-NH-$(CH_2)_4$-NH-$(CH_2)_2$-, 

and , and

wherein m ranges from 1 to 10.

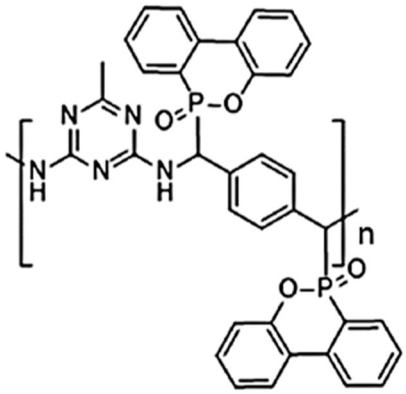
2. The flame retardant synergist of claim 1, wherein the flame retardant synergist is absent of a halogen and a halide.

3. The flame retardant synergist of claim 1 or 2, wherein the one or more side units are derived from



and/or .

4. The flame retardant synergist of any one of claims 1 to 3, wherein the flame retardant synergist comprises:



wherein n ranges from 5 to 1000.

5. A method of forming the flame retardant synergist of any one of claims 1 to 4, the method comprising:

dissolving the substituted triazine and the dialdehyde in a mixture of organic solvents, wherein the substituted triazine has at least two amino groups and the dialdehyde has the terminal aldehyde to form a first reaction mixture; and

mixing 9,10-dihydro-9-oxa-10-phosphaphenanthrene 10-oxide or a derivative thereof with the first reaction mixture.

6. The method of claim 5, wherein the mixture of organic solvents comprises an alcohol and dimethylacetamide.

7. The method of claim 5 or 6, wherein the dissolving and/or the mixing is carried out at a temperature of 80°C to 150°C.

8. The method of any one of claims 5 to 7, wherein the dissolving is carried out for a duration of more than 12 hours.

9. The method of any one of claims 5 to 8, wherein the mixing is carried out for a duration of at least 48 hours.

10. A flame retardant polymer composite comprising:

a polymer comprising a thermoplastic;

the flame retardant synergist of any one of claims 1 to 4; and

a flame retardant additive.

11. The flame retardant polymer composite of claim 10, wherein the thermoplastic comprises a polyamide or a polyethylene.

12. The flame retardant polymer composite of claim 10 or 11, further comprising a char forming agent and/or a blowing agent.

13. A method of producing the flame retardant polymer composite of any one of claims 10 to 12, the method comprising:

mixing the flame retardant synergist of any one of claims 1 to 4 with a flame retardant agent to form a pre-mix; and

compounding the pre-mix with a polymer to form the flame retardant polymer composite.

14. The method of claim 13, wherein the flame retardant synergist and the flame retardant agent is mixed in weight ratio of 1:3 to 1:4.

15. The method of claim 13 or 14, wherein the loading of the flame retardant synergist and the flame retardant additive in the flame retardant polymer composite is less than 12.5 wt%.