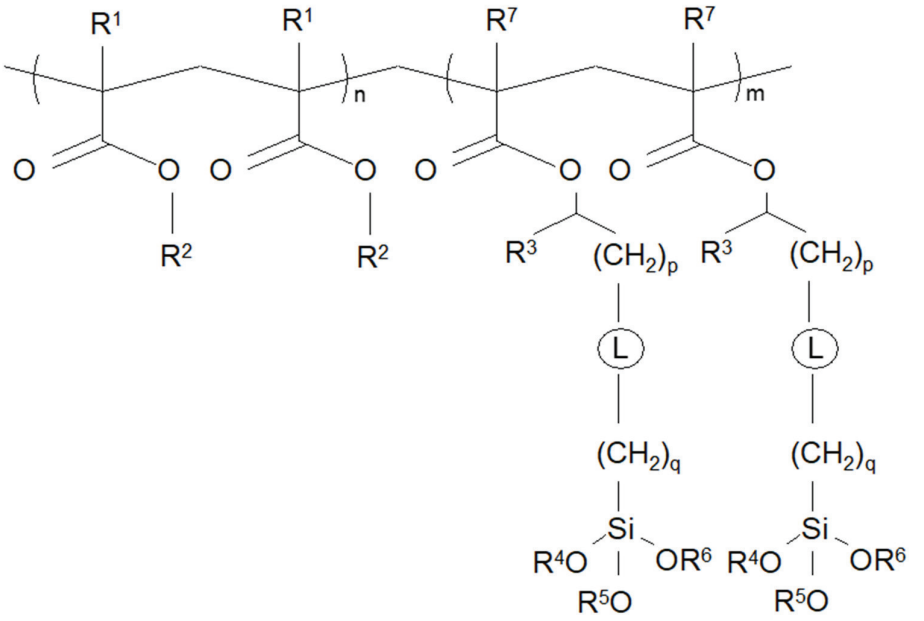
JPH-02258815 A describes a copolymer obtained by copolymerising triorganosilyl (meth)acrylate with a triorganosiloxysilylalkylene group-containing (meth)acrylate.

Block copolymers are a special class of copolymers that are made of blocks of different polymerized monomeric units. The block copolymers can combine the properties of the individual polymer types within themselves and are therefore very interesting for many applications. Therefore, it is desirable to provide a block copolymer that advantageously combines properties of both acrylate as well as silane polymers.

In one aspect, there is provided a polyacrylate-polysilane block copolymer of the general formula (I)



(I)

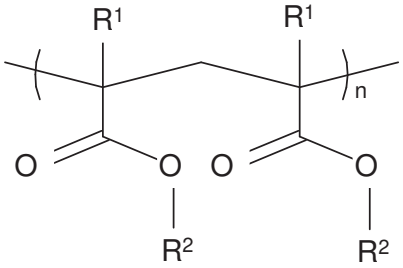
wherein

m and n	independent of one another, are integers ranging from 2 to 4000;
p	is an integer ranging from 0 to 5;
q	is an integer ranging from 1 to 5;

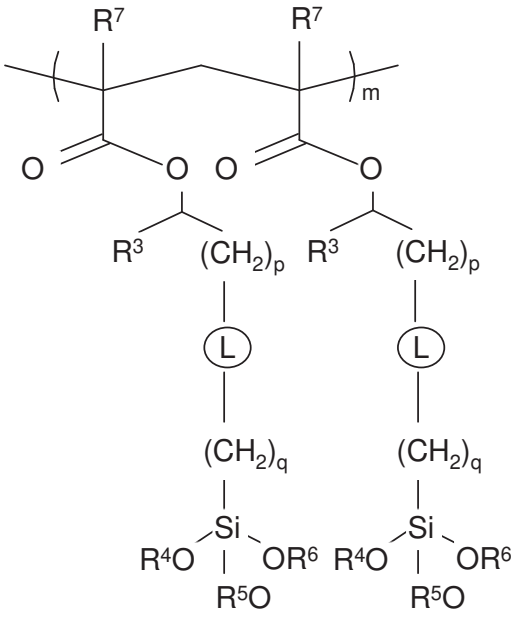
R^1	represents hydrogen, straight-chain or branched alkyl group having 1 to 4 carbon atoms;
R^2	represents hydrogen, straight-chain or branched alkyl group having 1 to 18 carbon atoms;
R^3	represents hydrogen, hydroxyl group, straight-chain or branched alkyl group having 1 to 4 carbon atoms, or an C_6-C_{14}-aryl group;
L	is a single bond or bivalent group -NH-, -C(O)NH-, -NHC(O)NH-, -OC(O)NH- or $-CH_2-$;
R^4, R^5 and R^6	independent of one another, represent hydrogen, straight-chain or branched alkyl group having 1 to 8 carbon atoms or a polydimethylsiloxane residue having a terminal group of OH; and
R^7	represents hydrogen or methyl group,

wherein the number average molecular weight of the polydimethylsiloxane residue is in the range of 500 g/mole to 300,000 g/mole.

In another aspect, there is provided a method for preparing a polyacrylate-polysilane block copolymer as described herein, comprising the step of polymerizing an acrylate polymer of formula “block (A)” and a silane polymer of formula “block (B)” at a reaction temperature of at most 120 °C



block (A)



block (B)

wherein m, n, p, q, L, R^1 to R^7 are as described above.

In another aspect, there is provided the use of a polyacrylate-polysilane block copolymer as described herein to enhance the scratch-resistance of polymers.

As used herein, “n” represents the degree of polymerization of the polyacrylate block (A) of the polyacrylate-polysilane block copolymer of formula (I). In a preferred embodiment, n is in a range of from 10 to 3000, more preferably from 50 to 2500, most preferably from 100 to 1000.

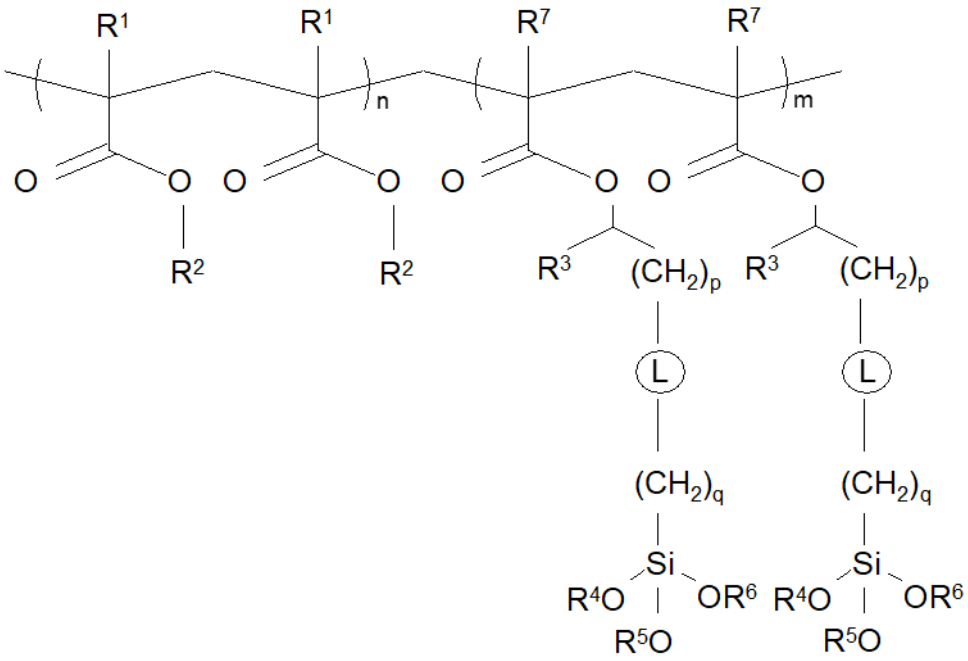
As used herein “m” represents the degree of polymerization of the polysilane block (B) of the polyacrylate-polysilane block copolymer of formula (I). In a preferred embodiment, m is in a range of 10 to 3000, more preferably from 50 to 2500, most preferably from 100 to 1000.

Preferred R^1 groups include hydrogen, methyl, ethyl, propyl, isopropyl, butyl, iso-butyl, more preferred are hydrogen, methyl and ethyl.

Preferred R^2 groups include hydrogen, methyl, ethyl, propyl, isopropyl, butyl, iso-butyl, more preferred are hydrogen, methyl and ethyl. In one particularly preferred embodiment, R^1 is hydrogen and R^2 is hydrogen. In another particularly preferred embodiment, R^1 is methyl and R^2 is hydrogen.

PATENT CLAIMS

1. A polyacrylate-polysilane block copolymer of general structure (I):



(I)

wherein

m and n	independent of one another, are integers ranging from 2 to 4000;
p	is an integer ranging from 0 to 5;
q	is an integer ranging from 1 to 5;
R^1	represents hydrogen, straight-chain or branched alkyl group having 1 to 4 carbon atoms;
R^2	represents hydrogen, straight-chain or branched alkyl group having 1 to 18 carbon atoms;
R^3	represents hydrogen, hydroxyl group, straight-chain or branched alkyl group having 1 to 4 carbon atoms, or an C_6-C_{14}-aryl group;
L	is a single bond or a bivalent group -NH-, -C(O)NH-, -NHC(O)NH-, -OC(O)NH- or $-CH_2-$;
R^4, R^5 and R^6	independent of one another, represent hydrogen, straight-chain or branched alkyl group having 1 to 8 carbon atoms or a

polydimethylsiloxane residue having a terminal group of OH; and

R^7 represents hydrogen or methyl group,

wherein the number average molecular weight of the polydimethylsiloxane residue is in the range of 500 g/mole to 300,000 g/mole.

2. The polyacrylate-polysilane block copolymer as claimed in claim 1, wherein m is an integer ranging from 100 to 1000.

3. The polyacrylate-polysilane block copolymer as claimed in claim 1 or 2, wherein n is an integer ranging from 100 to 1000.

4. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein p is an integer ranging from 0 to 3.

5. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein q is an integer ranging from 1 to 3.

6. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein the weight ratio of the polyacrylate block (A) to the polysilane block (B) is in the range of 1:1.8 x 10^7 to 6204:1.

7. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein the weight ratio of polydimethylsiloxane (PDMS) to the total weight of the polyacrylate-polysilane block copolymer of general structure (I) is in the range of 1:2.8 to 1:24023.

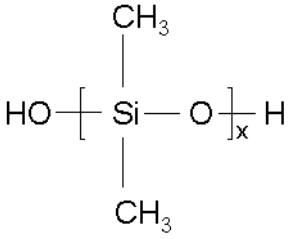
8. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein R^1 represents hydrogen, methyl or ethyl.

9. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein R^2 represents hydrogen, methyl or ethyl.

10. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein R^3 represents hydrogen.

11. The polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, wherein at least one of R^4, R^5 and R^6 represents a polydimethylsiloxane residue having a terminal –OH group.

12. The polyacrylate-polysilane block copolymer as claimed in claim 1, wherein the polydimethylsiloxane residue has the formula (II):

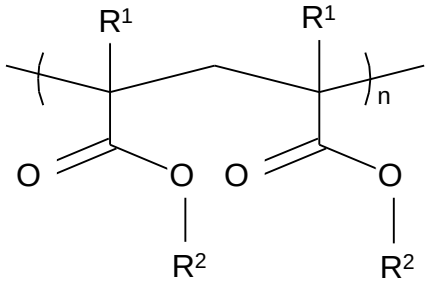


(II)

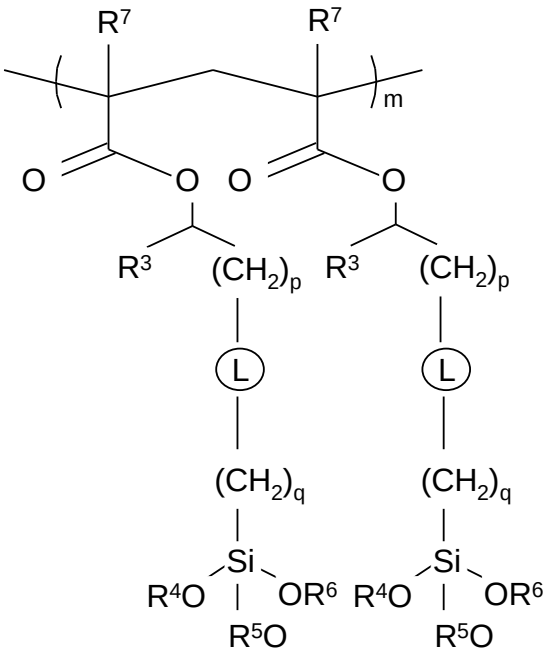
,

wherein x ranges from 6.5 to 4054.

13. A method for preparing a polyacrylate-polysilane block copolymer as claimed in any of the preceding claims, comprising the step of polymerizing an acrylate polymer of formula “block (A)” and a silane polymer of formula “block (B)” at a reaction temperature of at most 120 °C



block (A)



block (B)

wherein m, n, p, q, L, R^1 to R^7 are as defined in claim 1.

14. The method of claim 13, further comprising grafting at least one PDMS residue onto block (B).

15. Use of a polyacrylate-polysilane block copolymer as claimed in any of the preceding claims to enhance the scratch-resistance of polymers.