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(71) Applicant *(for all designated States except US)*: **P2I LTD** [GB/GB]; Unit 14, Central 127, Abingdon, Oxfordshire OX14 4SA (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **COULSON, Stephen** [GB/GB]; 18 Neave Mews, Abingdon, Oxfordshire OX14 5FP (GB).

(74) Agents: **GREAVES, Carol, P.** et al.; Greaves Brewster LLP, Indigo House, Cheddar Business Park, Wedmore Road, Cheddar, Somerset BS27 3EB (GB).

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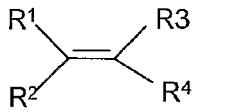
(54) Title: NOVEL PRODUCTS



(I)

(57) Abstract: An electrical or electronic device having a polymeric coating, formed by exposing said device to pulsed plasma comprising a compound of formula (I) where R^1, R^2 and R^3 are independently selected from hydrogen, alkyl, haloalkyl or aryl optionally substituted by halo; and R^4 is a group $X\text{-}R^5$ where R^5 is an alkyl or haloalkyl group and X is a bond; a group of formula -C (O) O $(CH_2)_n$Y- where n is an integer of from 1 to 10 and Y is a bond or a sulphonamide group; or a group - $(O)_p R^6 (O)_q (CH_2)_t$- where R^6 is aryl optionally substituted by halo, p is 0 or 1, q is 0 or 1 and t is 0 or an integer of from 1 to 10, provided that where q is 1, t is other than 0, for a sufficient period of time to allow a polymeric layer to form on the surface of the electrical or electronic device. Devices of this type are protected from contamination by liquids, in particular environmental liquids.

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Novel Products

The present invention relates to novel products in the form of electronic or electrical devices, which are treated to protect them from liquid damage, for example from environmental damage in particular from water or other liquids, as well as to processes for their production.

It is well known that electronic and electrical devices are very sensitive to damage caused by contamination by liquids such as environmental liquids, in particular water. Contact with liquids, either in the course of normal use or as a result of accidental exposure, can lead to short circuiting between electronic components, and irreparable damage to circuit boards, electronic chips etc.

The problem is particularly acute in relation to small portable electronic equipment such as mobile phones, pagers, radios, hearing aids, laptop, notebook, palmtop computers and personal digital assistants (PDAs), which can be exposed to significant liquid contamination when moved outside. In addition, they are prone to accidental exposure to liquids, for example if dropped or splashed.

In addition, other types of electronic or electrical devices are particularly prone to for example, environmental damage because of their location, for example outdoor lighting systems, radio antenna and other forms of communication equipment.

However, most devices of this type are damaged by accidental spillage or the like. Particular examples may include desktop devices such as keyboards, or instrumentation for instance used in control rooms.

A particular problem arises in relation to devices which are used in sound reproduction and which utilise transducers such as loudspeakers, microphones, ringers and buzzers. These are particularly susceptible to damage by liquid contamination, either as a result of accidental exposure or from environmental factors such as rain or spray in use. In many cases, the membranes or diaphragms used in the devices, particularly the most economical ones, are liquid absorbent to some degree, and when exposed to water for example, will absorb considerable amounts. This affects the operability of the transducer significantly and the quality of the sound reproduction therefore suffers.

Many microphones are provided with an open-pore foamed plastic enclosure surrounding the transducer. However, these must be gas permeable and they do not provide complete protection against liquid contamination.

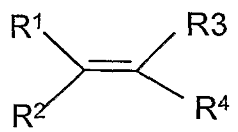
In the past, this problem has been addressed by introducing further water protective measures in the microphones. In many cases, these comprise water-impermeable porous membranes such as polytetrafluoroethylene (PTFE) membranes (see for example WO/01/03468 or USP 5,420,570) into the device. In all cases, these membranes will reduce the sensitivity of the transducer and therefore have an adverse impact on sound quality.

In other cases, such as that described in GB 2,364,463, more rigid protective covers are provided, which are solid and holes into which pick-up devices are inserted. This solution is costly and complex and only suitable in certain limited situations.

Plasma deposition techniques have been quite widely used for the deposition of polymeric coatings onto a range of surfaces, and in particular onto fabric surfaces. This technique is recognised as being a clean, dry technique that generates little waste compared to conventional wet chemical methods. Using this method, plasmas are generated from organic molecules, which are subjected to an electrical field. When this is done in the presence of a substrate, the radicals of the compound in the plasma polymerise on the substrate. Conventional polymer synthesis tends to produce structures containing repeat units that bear a strong resemblance to the monomer species, whereas a polymer network generated using a plasma can be extremely complex. The properties of the resultant coating can depend upon the nature of the substrate as well as the nature of the monomer used and conditions under which it is deposited.

The applicants have found that by utilising a specific type of monomer under particular deposition conditions, electronic or electrical devices having highly liquid repellent nano-coatings thereon can be produced, which does not affect the efficacy of the device.

According to the present invention there is provided an electronic or electrical device having a polymeric coating, formed by exposing said device to pulsed plasma comprising a compound of formula (I)



(I)

where R^1, R^2 and R^3 are independently selected from hydrogen, alkyl, haloalkyl or aryl optionally substituted by halo; and R^4 is a group $X-R^5$ where R^5 is an alkyl or haloalkyl group and X is a bond; a group of formula $-C(O)O(CH_2)_nY-$ where n is an integer of from 1 to 10 and Y is a bond or a sulphonamide group; or a group $-(O)_pR^6(O)_q(CH_2)_t-$ where R^6 is aryl optionally substituted by halo, p is 0 or 1, q is 0 or 1 and t is 0 or an integer of from 1 to 10, provided that where q is 1, t is other than 0, for a sufficient period of time to allow a protective polymeric layer to form on the surface of the electrical or electronic device.

As used herein, the expression "in a gaseous state" refers to gases or vapours, either alone or in mixture, as well as aerosols.

The expression "protective polymeric layer" refers to polymeric layers which provide some protection against liquid damage, and in particular are liquid (such as oil- and water-) repellent. Sources of liquids from which the devices are protected include environmental liquids such as water, and in particular rain, as well as any other oil or liquid, which may be accidentally spilled.

As used herein, the term "electronic or electrical device" refers includes any piece of electrical or electronic equipment which may be used, as well as components thereof such as printed circuit boards (PCBs), transistors, resistors, electronic components or semi-conductor chips. In particular however, the coating is applied to the outer surface of a fully assembled device, for example the fully assembled mobile phone, or microphone. In such cases, the polymer layer will be applied to, for example an outer casing or foam cover, as well as any exposed components such as control buttons or switches, so as to prevent any liquid reaching the components within.

The applicants have found that the polymer layer forms across the entire surface of the device, including where the device includes different substrate materials, such as a combination of different plastics (including foamed plastic), metals and/or glass surfaces, and surprisingly therefore, the entire device is made liquid repellent. Even where these are not in a water-tight relationship, for example push buttons on a mobile phone which are not fused to the surrounding casing, the polymer layer deposited in this way is sufficiently repellent to prevent liquids penetrating the device around the edge of the buttons into the device. Thus it has been found that mobile phones for example, which are generally very sensitive to liquid damage, can be fully immersed in water after the treatment of the invention, without any lasting harm.

As the coating is carried out without requiring immersion in any liquids, there is no risk to the operation of the device as a result of exposure to this procedure.

This broad applicability makes the present procedure particularly advantageous.

Particular examples of electrical and electronic devices include communications devices such as mobile phones and pagers, radios, and sound and audio systems such as loudspeakers, microphones, ringers or buzzers, hearing aids, personal audio equipment such as personal CD, tape cassette or MP3 players, televisions, DVD players including portable DVD players, video recorders, digi and other set-top boxes such as Sky, computers and related components such as laptop, notebook or palmtop computers, personal digital assistants (PDAs), keyboards, or instrumentation, games consoles in particular hand-held playstations and the like, or outdoor lighting systems.

Other particular examples may include electrical or electronic components which are particularly at risk of water contamination, such as those used in transport vehicles include aircraft and other transport equipment such as trains, automobiles in addition to other vehicles such as those used by the Military, and other devices such as washing machines and dishwashers.

In a particular embodiment, the electronic or electrical device is a microphone. By utilising the method defined above, highly advantageous microphones have been produced. In particular, the main features and benefits of using this approach are that by coating for example the casing in particular the foam cover of the microphone, the transducer is protected from liquid contamination without any loss of sound quality. Levels of protection equal to or better than those achieved using membranes are achieved without any resultant "muffling" of the sound quality, which is a feature of the use of such membranes.

When applied to the foam cover, the layer does not affect porosity of the foam. In other words, the layer is not sufficient to block the pores of the foam or to affect the air permeability in any way. However, the entire surface of the pores is made liquid repellent, and this is sufficient to ensure that liquids do not penetrate the foam.

However, similar advantages occur in relation to devices which incorporate small microphones such as communications devices and sound and audio systems as defined above, and in particular mobile phones, where coating of the finished phone may further enhance the levels of protection.

Electronic or electrical devices treated in this way are protected to a significant degree, against water and oil damage.

Precise conditions under which the plasma polymerization takes place in an effective manner will vary depending upon factors such as the nature of the polymer, the electrical or electronic device etc. and will be determined using routine methods and/or the techniques.

Suitable plasmas for use in the method of the invention include non-equilibrium plasmas such as those generated by radiofrequencies (Rf), microwaves or direct current (DC). They may operate at atmospheric or sub-atmospheric pressures as are known in the art. In particular however, they are generated by radiofrequencies (Rf).

Various forms of equipment may be used to generate gaseous plasmas. Generally these comprise containers or plasma chambers in which plasmas may be generated. Particular examples of such equipment are described for instance in WO2005/089961 and WO02/28548, the content of which is incorporated herein by reference, but many other conventional plasma generating apparatus are available.

In general, the item to be treated is placed within a plasma chamber together with the material to be deposited in gaseous state, a glow discharge is ignited within the chamber and a suitable voltage is applied, which may be pulsed.

The gas used within the plasma may comprise a vapour of the monomeric compound alone, but it may be combined with a carrier gas, in particular, an inert gas such as helium or argon. In particular helium is a preferred carrier gas as this can minimises fragmentation of the monomer.

When used as a mixture, the relative amounts of the monomer vapour to carrier gas is suitably determined in accordance with procedures which are conventional in the art. The amount of monomer added will depend to some extent on the nature of the particular monomer being used, the nature of the laboratory disposable being treated, the size of the plasma chamber etc. Generally, in the case of conventional chambers, monomer is delivered in an amount of from 50-250mg/min, for example at a rate of from 100-150mg/min. Carrier gas such as helium is suitably administered at a constant rate for example at a rate of from 5-90, for example from 15-30sccm. In some instances, the ratio of monomer to carrier gas will be in the range of from 100:1 to 1:100, for instance in the range of from 10:1 to 1:100, and in particular about 1:1 to 1:10. The precise ratio selected will be so as to ensure that the flow rate required by the process is achieved.

Alternatively, the monomer may be delivered into the chamber by way of an aerosol device such as a nebuliser or the like, as described for example in WO2003/097245 and WO03/101621, the content of which is incorporated herein by reference.

In some cases, a preliminary continuous power plasma may be struck for example for from 2-10 minutes for instance for about 4 minutes, within the chamber. This may act as a surface pre-treatment step, ensuring that the monomer attaches itself readily to the surface, so that as polymerisation occurs, the coating "grows" on the surface. The pre-treatment step may be conducted before monomer is introduced into the chamber, in the presence of only the inert gas.

The plasma is then suitably switched to a pulsed plasma to allow polymerisation to proceed, at least when the monomer is present.

In all cases, a glow discharge is suitably ignited by applying a high frequency voltage, for example at 13.56MHz. This is suitably applied using electrodes, which may be internal or external to the chamber, but in the case of the larger chambers are internal.

Suitably the gas, vapour or gas mixture is supplied at a rate of at least 1 standard cubic centimetre per minute (sccm) and preferably in the range of from 1 to 100sccm.

In the case of the monomer vapour, this is suitably supplied at a rate of from 80-300mg/minute, for example at about 120mg per minute depending upon the nature of the monomer, whilst the pulsed voltage is applied.

Gases or vapours may be drawn or pumped into the plasma region. In particular, where a plasma chamber is used, gases or vapours may be drawn into the chamber as a result of a reduction in the pressure within the chamber, caused by use of an evacuating pump, or they may be pumped or injected into the chamber as is common in liquid handling.

Polymerisation is suitably effected using vapours of compounds of formula (I), which are maintained at pressures of from 0.1 to 200mtorr, suitably at about 80-100mtorr.

The applied fields are suitably of power of from 40 to 500W, suitably at about 100W peak power, applied as a pulsed field. The pulses are applied in a sequence which yields very low average powers, for example in a sequence in which the ratio of the time on : time off is in the range of from 1:500 to 1:1500. Particular examples of such sequence are sequences where power is on for 20-50µs, for example about 30µs, and off for from 1000µs to 30000µs, in particular about 20000µs. Typical average powers obtained in this way are 0.01W.

The fields are suitably applied from 30 seconds to 90 minutes, preferably from 5 to 60 minutes, depending upon the nature of the compound of formula (I) and the electrical or electronic device etc.

Suitably a plasma chamber used is of sufficient volume to accommodate multiple electrical or electronic devices, in particular when these are small in size, for example up to 20,000 microphone heads can be processed at the same time with ease and much more is capably with the correct size equipment.

A particularly suitable apparatus and method for producing electrical or electronic devices in accordance with the invention is described in WO2005/089961, the content of which is hereby incorporated by reference.

In particular, when using high volume chambers of this type, the plasma is created with a voltage as a pulsed field, at an average power of from 0.001 to 500w/m^3, for example at from 0.001 to 100w/m^3 and suitably at from 0.005 to 0.5w/m^3.

These conditions are particularly suitable for depositing good quality uniform coatings, in large chambers, for example in chambers where the plasma zone has a volume of greater than 500cm^3, for instance 0.5m^3 or more, such as from 0.5m^3-10m^3 and suitably at about 1m^3. The layers formed in this way have good mechanical strength.

The dimensions of the chamber will be selected so as to accommodate the particular electrical or electronic device being treated. For instance, generally cuboid chambers may be suitable for a wide range of applications, but if necessary, elongate or rectangular chambers may be constructed or indeed cylindrical, or of any other suitable shape.

The chamber may be a sealable container, to allow for batch processes, or it may comprise inlets and outlets for electrical or electronic devices, to allow it to be utilised in a continuous process. In particular in the latter case, the pressure conditions necessary for creating a plasma discharge within the chamber are maintained using high volume pumps, as is conventional for example in a device with a "whistling leak". However it will also be possible to process certain items at atmospheric pressure, or close to, negating the need for "whistling leaks"

The monomers used are selected from monomers of formula (I) as defined above. Suitable haloalkyl groups for R^1, R^2, R^3 and R^5 are fluoroalkyl groups. The alkyl chains may be straight or branched and may include cyclic moieties.

For R^5, the alkyl chains suitably comprise 2 or more carbon atoms, suitably from 2-20 carbon atoms and preferably from 6 to 12 carbon atoms.

For R^1, R^2 and R^3, alkyl chains are generally preferred to have from 1 to 6 carbon atoms.

Preferably R^5 is a haloalkyl, and more preferably a perhaloalkyl group, particularly a perfluoroalkyl group of formula C_mF_{2m+1} where m is an integer of 1 or more, suitably from 1-20, and preferably from 4-12 such as 4, 6 or 8.

Suitable alkyl groups for R^1, R^2 and R^3 have from 1 to 6 carbon atoms.

In one embodiment, at least one of R^1, R^2 and R^3 is hydrogen. In a particular embodiment R^1, R^2, R^3 are all hydrogen. In yet a further embodiment however R^3 is an alkyl group such as methyl or propyl.

Where X is a group $-C(O)O(CH_2)_nY-$, n is an integer which provides a suitable spacer group. In particular, n is from 1 to 5, preferably about 2.

Suitable sulphonamide groups for Y include those of formula $-N(R^7)SO_2^-$ where R^7 is hydrogen or alkyl such as C_{1-4}alkyl, in particular methyl or ethyl.

In one embodiment, the compound of formula (I) is a compound of formula (II)

$$CH_2{=}CH{-}R^5 \qquad (II)$$

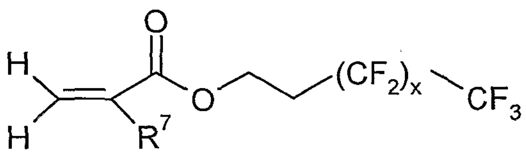
where R^5 is as defined above in relation to formula (I).

In compounds of formula (II), X in formula (I) is a bond.

However in a preferred embodiment, the compound of formula (I) is an acrylate of formula (III)

$$CH_2{=}CR^7C(O)O(CH_2)_nR^5 \qquad (III)$$

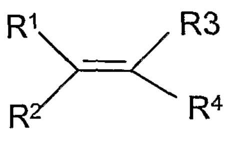
where n and R^5 as defined above in relation to formula (I) and R^7 is hydrogen, C_{1-10} alkyl, or C_{1-10}haloalkyl. In particular R^7 is hydrogen or C_{1-6}alkyl such as methyl. A particular example of a compound of formula (III) is a compound of formula (IV)



(IV)

where R^7 is as defined above, and in particular is hydrogen and x is an integer of from 1 to 9, for instance from 4 to 9, and preferably 7. In that case, the compound of formula (IV) is 1H,1H,2H,2H-heptadecafluorodecylacylate.

In a further aspect, the invention provides a method for protecting an electrical or electronic device against liquid damage said method comprising exposing said device to a pulsed plasma comprising a compound of formula (I)



(I)

where R^1, R^2 and R^3 are independently selected from hydrogen, alkyl, haloalkyl or aryl optionally substituted by halo; and R^4 is a group $X-R^5$ where R^5 is an alkyl or haloalkyl group and X is a bond; a group of formula $-C(O)O(CH_2)_nY-$ where n is an integer of from 1 to 10 and Y is a bond or a sulphonamide group; or a group $-(O)_pR^6(O)_q(CH_2)_t-$ where R^6 is aryl optionally substituted by halo, p is 0 or 1, q is 0 or 1 and t is 0 or an integer of from 1 to 10, provided that where q is 1, t is other than 0,
in a gaseous state for a sufficient period of time to allow a protective polymeric layer to form on the surface of the electrical or electronic device.

Liquid damage from which these devices are protected include environmental liquids such as water and in particular rain, or any other liquid, which may be accidentally spilled onto the device.

Suitably, the electrical or electronic device is placed in a plasma deposition chamber, a glow discharge is ignited within said chamber, and a voltage applied as a pulsed field.

Suitable monomers and reaction conditions for use in this method are as described above.

The invention will now be particularly described by way of example.

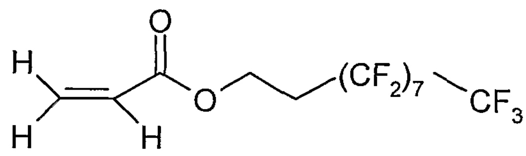
Example 1

Microphones

A set of 100 microphones were placed into a plasma chamber with a processing volume of ~ 300 litres. The chamber was connected to supplies of the required gases or vapours, via a mass flow controller and/or liquid mass flow meter and a mixing injector or any other vapour/gas introduction mechanism as appropriate.

The chamber was evacuated to between 3 - 10 mtorr base pressure before allowing helium into the chamber at 20 sccm until a pressure of 80 mtorr was reached. A continuous power plasma was then struck for 4 minutes using RF at 13.56 MHz at 300 W.

After this period, 1H,1H,2H,2H-heptadecafluorodecylacylate (CAS # 27905-45-9) of formula

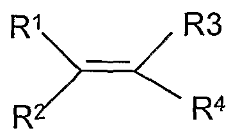


was brought into the chamber at a rate of 120 milli grams per minute and the plasma switched to a pulsed plasma at 30 micro seconds on-time and 20 milli seconds off-time at a peak power of 100 W for 40 minutes. On completion of the 40 minutes the plasma power was turned off along with the processing gases and vapours and the chamber evacuated back down to base pressure. The chamber was then vented to atmospheric pressure and the microphone heads removed.

It was found that the microphone heads were covered with an water and oil-repellent that protected it from challenge with water.

Claims

1. An electrical or electronic device having a polymeric coating, formed by exposing said device to pulsed plasma comprising a compound of formula (I)



(I)

where R^1, R^2 and R^3 are independently selected from hydrogen, alkyl, haloalkyl or aryl optionally substituted by halo; andR^4 is a group $X-R^5$ where R^5 is an alkyl or haloalkyl group and X is a bond; a group of formula $-C(O)O(CH_2)_nY-$ where n is an integer of from 1 to 10 and Y is a bond or a sulphonamide group; or a group $-(O)_pR^6(O)_q(CH_2)_t-$ where R^6 is aryl optionally substituted by halo, p is 0 or 1, q is 0 or 1 and t is 0 or an integer of from 1 to 10, provided that where q is 1, t is other than 0, for a sufficient period of time to allow a protective polymeric layer to form on the surface of the electrical or electronic device.

2. An electrical or electronic device according to claim 1, which is selected from communications devices, sound or audio systems devices, computers or computer-related components, outdoor lighting systems, or electrical or electronic devices used in transport vehicles, washing machines and dishwashers; or components of any of these.

3. An electrical or electronic device according to claim 2 which is a sound or audio system device.

4. An electrical or electronic device according to claim 3 which is a loudspeaker, microphone, ringer or buzzer.

5. An electrical or electronic device according to claim 4 which is a microphone.

6. An electrical or electronic device according to claim 4 wherein the microphone comprises a foamed plastic cover and the polymeric layer is present thereon.

7. An electrical or electronic device according to any one of the preceding claims wherein the electrical or electronic device is exposed to the pulsed plasma within a plasma deposition chamber.

8. An electrical or electronic device according to any one of the preceding claims wherein the compound of formula (I) is a compound of formula (II)

$$CH_2{=}CH\text{-}R^5 \qquad (II)$$

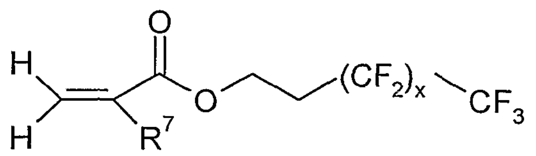
where R^5 is as defined in claim 1, or a compound of formula (III)

$$CH_2{=}CR^7C(O)O(CH_2)_nR^5 \qquad (III)$$

where n and R^5 as defined in claim 1 and R^7 is hydrogen, C_{1-10} alkyl, or C_{1-10}haloalkyl.

9. An electrical or electronic device according to claim 8 wherein the compound of formula (I) is a compound of formula (III).

10. An electrical or electronic device according to claim 9 wherein the compound of formula (III) is a compound of formula (IV)

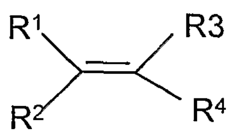


(IV)

where R^7 is as defined in claim 8, and x is an integer of from 1 to 9.

11. An electrical or electronic device according to claim 10 wherein the compound of formula (IV) is is 1H,1H,2H,2H-heptadecafluorodecylacylate.

12. A method for protecting an electrical or electronic device against liquid damage, said method comprising exposing said device to a pulsed plasma comprising a compound of formula (I)



(I)

where R^1, R^2 and R^3 are independently selected from hydrogen, alkyl, haloalkyl or aryl optionally substituted by halo; and R^4 is a group $X-R^5$ where R^5 is an alkyl or haloalkyl group and X is a bond; a group of formula $-C(O)O(CH_2)_nY-$ where n is an integer of from 1 to 10 and Y is a bond or a sulphonamide group; or a group $-(O)_pR^6(O)_q(CH_2)_t-$ where R^6 is aryl optionally substituted by halo, p is 0 or 1, q is 0 or 1 and t is 0 or an integer of from 1 to 10, provided that where q is 1, t is other than 0,

in a gaseous state for a sufficient period of time to allow a polymeric layer to form on the surface of the electrical or electronic device.

13. A method according to claim 12 wherein the electrical or electronic device is placed in a plasma deposition chamber, a glow discharge is ignited within said chamber, and a voltage applied as a pulsed field.

14. A method according to claim 12 or claim 13 wherein applied voltage is at a power of from 40 to 500W.

15. A method according to any one of claims 12 to 14 wherein the voltage is pulsed in a sequence in which the ratio of the time on : time off is in the range of from 1:500 to 1:1500.

16. A method according to claim 15 wherein the voltage is pulsed in a sequence where power is on for 20-50μs, and off for from 1000μs to 30000μs.

17. A method according to any one of claims 12 to 16 wherein the voltage is applied as a pulsed field at for a period of from 30 seconds to 90 minutes.

18. A method according to claim 17 wherein the voltage is applied as a pulsed field for from 5 to 60 minutes.

19. A method according to any one of claims 12 to 18, wherein in a preliminary step, a continuous power plasma is applied to the electrical or electronic device.

20. A method according to claim 19 wherein the preliminary step is conducted in the presence of an inert gas.

21. A method according to any one of claims 12 to 20 wherein the compound of formula (I) in gaseous form is fed into the plasma at a rate of from 80-300 mg/minute, whilst the pulsed voltage is applied.

22. A method according to any one of claims 12 to 21 wherein the plasma is created with a voltage at an average power of from 0.001 to 500w/m^3.

23. A method according to claim 22 wherein the plasma is created with a voltage at an average power of from 0.001 to 100w/m^3.

24. A method according to claim 23 wherein the plasma is created with a voltage at an average power of from 0.005 to 0.5w/m^3.

25. A method according to any one of claims 12 to 24 wherein wherein the compound of formula (I) is a compound of formula (II)

$$CH_2=CH-R^5 \qquad (II)$$

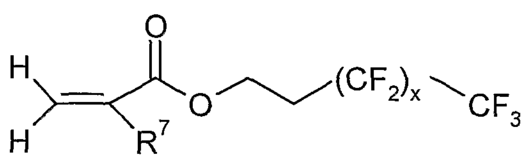
where R^5 is as defined in claim 1, or a compound of formula (III)

$$CH_2=CR^7C(O)O(CH_2)_nR^5 \qquad (III)$$

where n and R^5 as defined in claim 1 and R^7 is hydrogen, C_{1-10} alkyl, or C_{1-10}haloalkyl.

26. A method according to claim 25 wherein the compound of formula (I) is a compound of formula (III).

27. A method according to claim 26 wherein the compound of formula (III) is a compound of formula (IV)



(IV)

where R^7 is as defined in claim 8, and x is an integer of from 1 to 9.

28. A method according to claim 26 wherein the compound of formula (IV) is 1H,1H,2H,2H-heptadecafluorodecyl acrylate.

29. An electrical or electronic device substantially as hereinbefore described with reference to the examples.

30. A method for protecting an electrical or electronic device against liquid damage, substantially as hereinbefore described with reference to the Examples.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/000149

A. CLASSIFICATION OF SUBJECT MATTER
INV. C09D4/00 B05D7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C09D B05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 98/58117 A (SECR DEFENCE [GB]; BADYAL JAS PAL SINGH [GB]; COULSON STEPHEN RICHARD) 23 December 1998 (1998-12-23) the whole document	1-30
X	EP 1 557 489 A (SEC DEP FOR DEFENCE IN HERBRIT [GB]) 27 July 2005 (2005-07-27) the whole document	1-30

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2007	04/05/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Droghetti, Anna

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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