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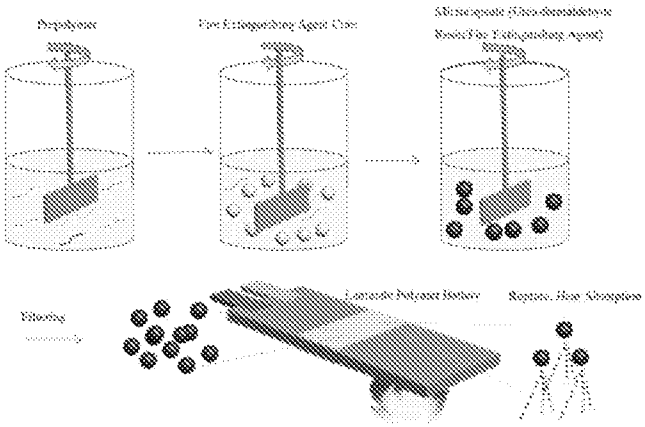
(54) **A new kind of multi-function a high-efficiency fire extinguishing agent and its preparation method.**

(57) The invention provides a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method. By preparing melamine urea-formaldehyde resin prepolymer and mixing it with montmorillonite, defoamer and perfluorohexanone and heptafluorocyclopentane as fire extinguishing materials, the invention prepares a high-efficiency fire extinguishing agent with core-shell structure, which takes melamine urea-formaldehyde resin as shell material and perfluorohexanone and heptafluorocyclopentane as core materials; and by loading the prepared high-efficiency fire extinguishing agent on the outer surface of the lithium-ion battery, the invention provides an effective safety protection for the lithium-ion battery and ensures the fire safety of the lithium-ion battery. Through the above methods, the fire extinguishing process provided by the invention can rupture the high-efficiency fire extinguishing agent, release the fire extinguishing materials, and play a dual role of flame retardant and fire extinguishing in time when the lithium-ion battery is in the thermal runaway. In addition, the invention can ensure the fire extinguishing effect while taking into account the cooling capacity, so that the lithium-ion battery fire can be quickly extinguished and cooled, which can effectively prevent the lithium-ion battery from reignition, so as to ensure the service safety of the lithium-ion battery.



A new kind of multi-function a high-efficiency fire extinguishing agent and its preparation method

Technical Field

The invention relates to the technical field of fire safety, in particular to a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method.

Background Technology

In recent years, lithium-ion batteries have been widely used in portable products, standby power supplies, electric vehicles and other fields due to the advantages of high energy density and long cycle life, etc. However, during the process of long-term usage and storage, lithium-ion batteries inevitably face extrusion, breakdown, temperature shock, overcharge and other problems, resulting in short-circuit and other damage, and then cause combustion and even explosion, resulting in equipment damage, casualties and other accidents. Therefore, in the large-scale application of lithium-ion batteries, it is very important to solve the problem of fire safety.

In order to ensure the service safety of the lithium-ion battery, in addition to optimizing the internal materials of the battery and reducing the possibility of the fire, it is also necessary to establish an effective external protection mechanism to judge the fire by testing the temperature change or voltage change caused by the thermal runaway of the lithium-ion battery, and then spray the fire extinguishing agent to extinguish the lithium-ion battery fire and block the spread of the fire in time. However, because lithium-ion battery is a high-energy material, it has the characteristics of strong combustion, rapid thermal diffusion and strong toxicity, etc., the traditional fire extinguishing agent has limited fire extinguishing effect, which can only extinguish the open fire, but cannot fundamentally inhibit the occurrence of the fire. Moreover, the external protection of a series of fire extinguishing devices such as early-warning system, spraying and storage device will increase the weight and volume of lithium-ion batteries during application, which not only affects the application of lithium-ion batteries, but also is not absolutely reliable under the condition of thermal abuse. Therefore, how to select an appropriate fire extinguishing agent and design a new type of fire extinguishing device is a very meaningful research work for the large-scale application of lithium-ion batteries.

The patent with the publication number of CN109420281A provides a microcapsule automatic fire extinguishing agent. The patent uses the resin shell formed by the reaction of melamine and/or urea-formaldehyde and formaldehyde as the coating material to wrap the main fire extinguishing material to form a microcapsule; and mix the microcapsule with polymer resin, fiber, inorganic filler and other auxiliary materials to form a fire extinguishing agent that integrates detection, control, start-up and fire extinguishing units. However, the main fire extinguishing materials selected in the patent are not designed for lithium-ion battery fires. Although this type of main fire extinguishing materials can extinguish general

electrical fires, they do not have the dual functions of cooling and fire extinguishing, it is difficult to effectively inhibit the reignition of the lithium-ion battery fire.

In view of this, currently, it is still necessary to improve the existing fire extinguishing agents for the fire safety of the lithium-ion battery, and design corresponding protection strategies to ensure the service safety of the lithium-ion battery, so as to solve the above problems.

Summary of the Invention

In view of the defects of the above existing technology, the purpose of the invention is to provide a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method. By taking melamine urea-formaldehyde resin as shell material and perfluorohexanone and heptafluorocyclopentane as core materials, the invention prepares a high-efficiency fire extinguishing agent with core-shell structure; meanwhile, by loading the prepared high-efficiency fire extinguishing agent on the outer surface of the lithium-ion battery, the invention provides an effective safety protection for the lithium-ion battery, and plays a dual role of flame retardant and fire extinguishing in time when the lithium-ion battery is in the thermal runaway, so as to ensure the service safety of the lithium-ion battery.

In order to achieve the above purpose, the invention provides A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method, which comprises the following steps:

S1. Prepare melamine urea-formaldehyde resin prepolymer;

S2. Prepare montmorillonite suspension; and fully mix the montmorillonite suspension with the fire extinguishing material, the defoamer and the melamine urea-formaldehyde resin prepolymer obtained in step S1 according to the preset ratio, filter and dry to obtain a high-efficiency fire extinguishing agent;

S3. Load the high-efficiency fire extinguishing agent obtained in step S2 uniformly on the outer surface of the aluminum-plastic film of the lithium-ion battery.

As a further improvement of the invention, in step S2, the fire extinguishing material is composed of perfluorohexanone and heptafluorocyclopentane according to the preset ratio.

As a further improvement of the invention, in step S2, the mass ratio of the perfluorohexanone to the heptafluorocyclopentane is (0.5~2): 1.

As a further improvement of the invention, in step S1, the preparation for the melamine urea-formaldehyde resin prepolymer specifically comprises the following steps:

After mixing the melamine, urea, formaldehyde solution and water uniformly according to the preset molar ratio, adjust the pH to 8.5~9.0, heat and stir to make them react fully, then add ice water to cool down quickly, and dilute to obtain a melamine urea-formaldehyde resin prepolymer with predetermined concentration.

As a further improvement of the invention, in step S1, the molar ratio of the melamine, the urea to the formaldehyde is 1: (1~3): (2~9);

As a further improvement of the invention, in step S1, the concentration of the prepared melamine urea-formaldehyde resin prepolymer is 1~50wt%.

As a further improvement of the invention, the particle size of the high-efficiency fire extinguishing agent is 50~100μm.

As a further improvement of the invention, in step S2, the volume ratio of the

montmorillonite suspension, the fire extinguishing material to the melamine urea-formaldehyde resin prepolymer is (1~4):1:(2~6); the concentration of the montmorillonite suspension is 0.1~1wt%.

As a further improvement of the invention, in step S2, the montmorillonite suspension is obtained by ultrasonic exfoliation of natural montmorillonite in distilled water; the power of the ultrasonic exfoliation process is 10~50 kHZ and the time is 1~2h.

As a further improvement of the invention, in step S2, the defoamer includes, but is not limited to, one or more mixtures of potassium heptafluorooctane sulfonate, sodium dodecylbenzenesulfonate, polydimethylsiloxane and n-octyl alcohol.

In order to achieve the above purpose, the invention also providesA new kind of multi-functiona high-efficiency fire extinguishing agent, the fire extinguishing agent is prepared according to the method provided by steps S1~S2 as described in the above technical solutions, comprising melamine urea-formaldehyde resin as shell material and fire extinguishing material as core material; the fire extinguishing material comprises perfluorohexanone and heptafluorocyclopentane.

The beneficial effects of the invention are as follows:

(1) By taking melamine urea-formaldehyde resin as shell material and perfluorohexanone and heptafluorocyclopentane as core materials, the invention prepares a high-efficiency fire extinguishing agent with core-shell structure, changes the liquid fire extinguishing agent into solid microcapsule, breaks through the traditional external protection mechanism, and realizes the micro-precision control of the flame retardant material and the fire extinguishing agent. Meanwhile, by loading the prepared high-efficiency fire extinguishing agent on the outer surface of the aluminum-plastic film of the lithium-ion battery, the invention can provide an effective safety protection for the lithium-ion battery, and play a dual role of flame retardant and fire extinguishing in time when the lithium-ion battery is in the thermal runaway, so as to ensure the service safety of the lithium-ion battery.

(2) By mixing perfluorohexanone and heptafluorocyclopentane according to a certain ratio, the invention prepares a composite fire extinguishing material for the lithium-ion battery, and uses it as the core material of a high-efficiency fire extinguishing agent, which can not only use the excellent fire extinguishing performance of perfluorohexanone to effectively extinguish the open fire of the lithium-ion battery, but also use the vaporization and heat absorption effect of heptafluorocyclopentane to achieve excellent cooling effect. On this basis, by adjusting the ratio of perfluorohexanone to heptafluorocyclopentane, the invention can make the obtained core material have a suitable boiling point and a higher heat of vaporization and specific heat, so as to ensure the fire extinguishing effect while taking into account the cooling capacity, so that the lithium-ion battery fire can be quickly extinguished and cooled under the action of the composite fire extinguishing material, and the reignition of the lithium-ion battery can be effectively prevented.

(3) Based on the characteristics of low boiling point and high vapor pressure of perfluorohexanone used in fire extinguishing materials, the invention prepare a melamine urea-formaldehyde resin as shell material with melamine, urea and formaldehyde as raw materials. The shell material has the advantages of high cross-linking density, good compactness and high mechanical strength, etc., and its flame retardant effect can also effectively prevent the fire from spreading when a lithium-ion battery fire occurs. During use, the shell material is easy to crack, which can release the wrapped fire extinguishing agent to

extinguish the early fire source and realize the dual function of flame retardant material and fire extinguishing. Meanwhile, the invention modifies the melamine urea-formaldehyde resin shell material by adding montmorillonite when preparing the high-efficiency fire extinguishing agent, which can improve the surface roughness of the fire extinguishing agent, thus further improving its thermal conductivity and stability, and making the liquid fire extinguishing agent as the core material can be stably stored under the coating of the melamine urea-formaldehyde resin shell material. On this basis, the invention also effectively removes the gas foam in the reaction solution by adding a defoamer, thus ensuring the completeness of the wall material after the fire extinguishing agent is formed, and there is no foam in the liquid fire extinguishing agent wrapped inside, thus further improving the stability and extinguishing effect of the high-efficiency fire extinguishing agent.

(4) By directly loading the prepared high-efficiency fire extinguishing agent on the surface of the lithium-ion battery, the invention can effectively break through the traditional external protection mechanism, and conveniently and effectively establish a safety protection for the lithium-ion battery without affecting the use of the lithium-ion battery. When the lithium-ion battery is in the internal thermal runaway and reaches a certain temperature, the high-efficiency fire extinguishing agent loaded on the surface of the lithium-ion battery will rupture automatically, thus releasing the fire extinguishing material, quickly blocking the thermal runaway process of the lithium-ion battery, extinguishing the early fire source, preventing it from spreading, meanwhile, achieving the cooling effect on the lithium-ion battery, and avoiding the occurrence of reignition, so as to ensure the service safety of the lithium-ion battery.

Brief Description of Drawings

Figure 1 is a flow diagram of A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method provided by the invention.

Figure 2 is a schematic diagram of the covering position of the new kind of multi-functiona high-efficiency fire extinguishing agent in the lithium-ion laminate polymer battery in the fire extinguishing process provided by the invention.

Detailed Description of the Presently Preferred Embodiments

In order to make the purpose, technical solutions and advantages of the invention clearer, the invention will be described in detail below in combination with the drawings and specific embodiments.

Here, it should also be noted that in order to avoid obscuring the invention due to unnecessary details, only the structure and/or processing steps closely related to the solutions of the invention are shown in the drawings, and other details that are not related to the invention are omitted.

In addition, it should also be noted that the terms “Comprising”, “Including” or any other variation are intended to cover non-exclusive inclusion, so that a process, method, item or equipment comprising a series of elements comprises not only those elements, but also other elements that are not explicitly listed, or also those elements inherent to such process, method, item or equipment.

The invention provides a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method, which comprises the following steps:

S1. Prepare melamine urea-formaldehyde resin prepolymer;

S2. Prepare montmorillonite suspension; and fully mix the montmorillonite suspension with the fire extinguishing material, the defoamer and the melamine urea-formaldehyde resin prepolymer obtained in step S1 according to the preset ratio, filter and dry to obtain a high-efficiency fire extinguishing agent;

S3. Load the high-efficiency fire extinguishing agent obtained in step S2 uniformly on the outer surface of the aluminum-plastic film of the lithium-ion battery.

In step S1, the preparation for the melamine urea-formaldehyde resin prepolymer specifically comprises the following steps:

After mixing the melamine, urea, formaldehyde solution and water uniformly according to the preset molar ratio, adjust the pH to 8.5~9.0, heat and stir to make them react fully, then add ice water to cool down quickly, and dilute to obtain a melamine urea-formaldehyde resin prepolymer with predetermined concentration; the molar ratio of the melamine, the urea to the formaldehyde is 1: (1~3): (2~9); the concentration of the prepared melamine urea-formaldehyde resin prepolymer is 1~50wt%.

In step S2, the montmorillonite suspension is obtained by ultrasonic exfoliation of natural montmorillonite in distilled water; the power of the ultrasonic exfoliation process is 10~50 kHZ and the time is 1~2h; the fire extinguishing material is composed of perfluorohexanone and heptafluorocyclopentane according to the preset ratio; the mass ratio of the perfluorohexanone to the heptafluorocyclopentane is (0.5~2). The volume ratio of the montmorillonite suspension, the fire extinguishing material to the melamine urea-formaldehyde resin prepolymer is (1~4):1:(2~6); the concentration of the montmorillonite suspension is 0.1~1wt%; the particle size of the high-efficiency fire extinguishing agent is 50~100μm; the defoamer includes, but is not limited to, one or more mixtures of potassium heptafluorooctane sulfonate, sodium dodecylbenzenesulfonate, polydimethylsiloxane and n-octyl alcohol.

A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method provided by the invention will be described below in combination with specific embodiments.

Embodiment 1

The embodiment provides a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method, the schematic diagram of the process flow is shown in Figure 1, which specifically comprises the following steps:

S1. Prepare Melamine Urea-formaldehyde Resin Prepolymer

Add 7.76g melamine, 7.40g urea, 29.98g formaldehyde solution (the concentration is 37wt%) and 30g distilled water into the three-neck flask, adjust the pH to 8.5~9.0 with anhydrous sodium carbonate, then heat the three-neck flask in the water bath, gradually increase the water bath temperature from 30℃ to 70℃ at the rate of 2.5℃/min, stir for 1h, and then add ice water to quickly reduce the temperature to below 40℃. Then dilute it with 375g distilled water to obtain a melamine urea-formaldehyde resin (MUF) prepolymer with a concentration of 10wt%.

S2. Prepare High-efficiency Fire Extinguishing Agent

Add 0.06g natural montmorillonite powder to 32mL distilled water, and exfoliate it in an ultrasonic bath at 20kHZ for 1.5h to obtain a transparent, slightly milky white montmorillonite suspension; then, mix the montmorillonite suspension with 5mL perfluorohexanone, 5mL heptafluorocyclopentane, 0.3g potassium heptafluorooctane sulfonate and 50mL 10wt% MUF prepolymer prepared in step S1, and stir them at the speed of 500r/min for 6h, and then place the obtained solution for at least 6h, filter and dry to obtain a high-efficiency fire extinguishing agent with an average particle size of 80μm.

S3. Lithium-ion Battery Protection

Coat the high-efficiency fire extinguishing agent obtained in step S2 uniformly on the outer surface of the middle part of the aluminum-plastic film of the lithium-ion laminate polymer battery (3.7V, 2000mA), and the covering position of the high-efficiency fire extinguishing agent is shown in Figure 2.

In order to analyze the composition of the fire extinguishing agent prepared in the embodiment, perform an energy spectrum test on the fire extinguishing agent before and after rupture, and the results are shown in Table 1.

Table 1 Weight Comparison of Different Elements in Complete Fire Extinguishing Agent and Ruptured Fire Extinguishing Agent after Releasing the Fire Extinguishing Agent

	C	N	O	F
Complete Fire Extinguishing Agent	26.67	18.12	7.94	47.27
Ruptured Fire Extinguishing Agent	40.54	36.20	14.17	9.09

Combined with Table 1, it can be seen that the C, N and O elements in the complete fire extinguishing agent are uniformly distributed in the entire microcapsule structure, but the F element is concentrated in the middle of the fire extinguishing agent, which proves that the fire extinguishing materials (perfluorohexanone and heptafluorocyclopentane) are wrapped in the microcapsule structure. When the fire extinguishing agent ruptures and releases the fire extinguishing material, the content of F element decreases significantly and presents a more uniform distribution state, which indicates that the fire extinguishing material has been fully released.

In order to study the fire extinguishing effect of the new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method provided by the embodiment, perform a fire extinguishing test on the lithium-ion laminate polymer battery loaded with high-efficiency fire-fighting agent obtained in step S3.

Embodiments 2~9 and Comparative Examples 1~3

Embodiments 2~9 and Comparative Examples 1~3 respectively provide a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method. Compared with the Embodiment 1, the difference is that part of the preparation parameters in steps S1 and S2 are adjusted. The corresponding parameters of each embodiment and comparative example are shown in Table 2, and the remaining steps and parameters are consistent with the Embodiment 1, which will not be repeated here.

Table 2 Related Process Parameters of the Embodiments 2~9 and Comparative

Embodiment/ Comparative Example	Step S1	Step S2	
	Molar Ratio of Melamine, Urea to Formaldehyde	Mass Ratio of Perfluorohexanone to Heptafluorocyclopentane	Volume Ratio of Montmorillonite Suspension, Fire Extinguishing Material to Prepolymer
Embodiment 2	1:1:2	1:1	3:1:5
Embodiment 3	1:3:9	1:1	3:1:5
Embodiment 4	1:2:6	0.5:1	3:1:5
Embodiment 5	1:2:6	2:1	3:1:5
Embodiment 6	1:2:6	1:1	1:1:5
Embodiment 7	1:2:6	1:1	4:1:5
Embodiment 8	1:2:6	1:1	3:1:2
Embodiment 9	1:2:6	1:1	3:1:6
Comparative Example 1	1:2:6	1:0	3:1:5
Comparative Example 2	1:2:6	0:1	3:1:5
Comparative Example 3	1:2:6	1:1	0:1:5

Prepare the corresponding fire extinguishing agent according to the process parameters provided by the Embodiments 2-9 and Comparative Examples 1-3, and load it on the outer surface of the aluminum-plastic film of the lithium-ion battery according to the method of step S3 in Embodiment 1, and then test the fire extinguishing effect of each embodiment and comparative example.

After testing, the processes provided by the Embodiments 2-9 can effectively protect the lithium-ion batteries and have good fire extinguishing effects on the lithium-ion battery fires. The core material of the fire extinguishing agent provided by the Embodiment 1 is only heptafluorocyclopentane, and the core material of the fire extinguishing agent provided by the Comparative Example 2 is only perfluorohexanone. Compared with the microcapsule fire extinguishing agent containing both heptafluorocyclopentane and perfluorohexanone prepared in each embodiment of the invention, in the Comparative Examples 1 and 2, it is difficult for a single fire extinguishing agent component to achieve the effects of fire extinguishing and

cooling at the same time, resulting in poor fire extinguishing effects and easy reignition problems. In the Comparative Example 3, montmorillonite is not added in the process of preparing microcapsule fire extinguishing agent. Compared with the embodiments of the invention, the stability of the prepared microcapsule is relatively worse, and it is easy to be damaged in the storage process, resulting in a weakened fire extinguishing effect in practical application. Therefore, the high-efficiency fire extinguishing agent and its fire safety fire extinguishing process provided by the invention prepares a high-efficiency fire extinguishing agent with excellent fire extinguishing effect and higher stability, and provides an effective external protection mechanism for the lithium-ion battery by designing a composite fire extinguishing agent suitable for the lithium-ion battery, coating it with melamine urea-formaldehyde resin, and modifying it with montmorillonite.

In summary, the invention provides a new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method. By preparing melamine urea-formaldehyde resin prepolymer and mixing it with montmorillonite, defoamer and perfluorohexanone and heptafluorocyclopentane as fire extinguishing materials, the invention prepares a high-efficiency fire extinguishing agent with core-shell structure, which takes melamine urea-formaldehyde resin as shell material and perfluorohexanone and heptafluorocyclopentane as core materials; meanwhile, by loading the prepared high-efficiency fire extinguishing agent on the outer surface of the lithium-ion battery, the invention provides an effective safety protection for the lithium-ion battery. Through the above methods, the fire extinguishing process provided by the invention can rupture the high-efficiency fire extinguishing agent, release the fire extinguishing materials, and play a dual role of flame retardant and fire extinguishing in time when the lithium-ion battery is in the thermal runaway. In addition, the invention can ensure the fire extinguishing effect while taking into account the cooling capacity, so that the lithium-ion battery fire can be quickly extinguished and cooled, which can effectively prevent the lithium-ion battery from reignition, so as to ensure the service safety of the lithium-ion battery.

The above embodiments are only used to illustrate the technical solutions of the invention, and not to limit them. Although the invention has been described in detail with reference to the preferred embodiments, those ordinary technical personnel in the field should understand that the technical solutions of the invention can be modified or equivalently replaced, without departing from the spirit and scope of the technical solutions of the invention.

Claims

1. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method, which is characterized in that, it comprises the following steps:

S1. Prepare melamine urea-formaldehyde resin prepolymer;

S2. Prepare montmorillonite suspension; and fully mix the montmorillonite suspension with the fire extinguishing material, the defoamer and the melamine urea-formaldehyde resin prepolymer obtained in step S1 according to the preset ratio, filter and dry to obtain a high-efficiency fire extinguishing agent;

S3. Load the high-efficiency fire extinguishing agent obtained in step S2 uniformly on the outer surface of the aluminum-plastic film of the lithium-ion battery.

2. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 1, which is characterized in that: In step S2, the fire extinguishing material is composed of perfluorohexanone and heptafluorocyclopentane according to the preset ratio.

3. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 2, which is characterized in that: In step S2, the mass ratio of the perfluorohexanone to the heptafluorocyclopentane is (0.5~2): 1.

4. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 1, which is characterized in that: In step S1, the preparation for the melamine urea-formaldehyde resin prepolymer specifically comprises the following steps:

After mixing the melamine, urea, formaldehyde solution and water uniformly according to the preset molar ratio, adjust the pH to 8.5~9.0, heat and stir to make them react fully, then add ice water to cool down quickly, and dilute to obtain a melamine urea-formaldehyde resin prepolymer with predetermined concentration.

5. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 4, which is characterized in that: In step S1, the molar ratio of the melamine, the urea to the formaldehyde is 1: (1~3): (2~9); the concentration of the prepared melamine urea-formaldehyde resin prepolymer is 1~50wt%.

6. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 1 or 4, which is characterized in that: The particle size of the high-efficiency fire extinguishing agent is 50~100μm.

7. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 1, which is characterized in that: In step S2, the volume ratio of the montmorillonite suspension, the fire extinguishing material to the melamine urea-formaldehyde resin prepolymer is (1~4): 1: (2~6); the concentration of the montmorillonite suspension is 0.1~1wt%.

8. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in Claim 1, which is characterized in that: In step S2, the montmorillonite suspension is obtained by ultrasonic exfoliation of natural montmorillonite in distilled water; the power of the ultrasonic exfoliation process is 10~50 kHZ and the time is 1~2h.

9. A new kind of multi-functiona high-efficiency fire extinguishing agent and its preparation method as described in any one of Claims 1~8, which is characterized in that: In step S2, the defoamer includes, but is not limited to, one or more mixtures of potassium heptafluorooctane sulfonate, sodium dodecylbenzenesulfonate, polydimethylsiloxane and n-octyl alcohol.

10. A new kind of multi-functiona high-efficiency fire extinguishing agent , which is

characterized in that: The high-efficiency fire extinguishing agent is prepared according to the method provided by steps S1-S2 in the fire extinguishing process as described in any one of Claims 1~9, comprising melamine urea-formaldehyde resin as shell material and fire extinguishing material as core material; the fire extinguishing material comprises perfluorohexanone and heptafluorocyclopentane.

Revendications

1. Procédé d'extinction de sécurité incendie, caractérisé en ce qu'il comprend les étapes suivantes:

S1. Préparez le prépolymère de résine de mélamine urée formaldéhyde;

S2. Préparez la suspension de montmorillonite; et mélangez complètement la suspension de montmorillonite avec le matériau d'extinction d'incendie, le débulleur et le prépolymère de résine mélamine urée formaldéhyde obtenu à l'étape S1 selon un rapport prédéfini, et après filtrage et séchage, obtenez l'agent extincteur à haute rendement ;

S3. Chargez uniformément l'agent extincteur à haute rendement obtenu à l'étape S2 sur la surface externe de la membrane aluminium-plastique de la batterie lithium-ion.

2. Le procédé d'extinction de sécurité incendie décrit dans l'article I de la Demande des Droits se caractérise par le fait que le matériau d'extinction d'incendie décrit à l'étape S2 est mélangé avec la perfluorohexanone et l'heptafluorocyclopentane selon un rapport prédéfini.

3. Le procédé d'extinction de sécurité incendie décrit dans l'article II de la Demande des Droits se caractérise par le fait que le rapport massique de la perfluorohexanone et de l'heptafluorocyclopentane décrit à l'étape S2 est de (0.5~2):1.

4. Le procédé d'extinction de sécurité incendie décrit dans l'article I de la Demande des Droits se caractérise par le fait que les étapes de la préparation du prépolymère de résine de mélamine urée formaldéhyde décrites à l'étape S1 sont comme suivantes:

Après avoir uniformément mélangé la mélamine, l'urée, la solution de formaldéhyde et l'eau selon le rapport molaire préréglé, ajustez le pH à 8.5~9.0, chauffez et remuez pour réagir complètement, puis ajoutez de l'eau glacée pour refroidir rapidement et diluez pour obtenir le prépolymère de résine mélamine urée formaldehyde à une concentration prédéterminée.

5. Le procédé d'extinction de sécurité incendie décrit dans l'article IV de la Demande des Droits se caractérise par le fait que le rapport molaire de la mélamine, de l'urée et du formaldéhyde décrit à l'étape S1 est de 1:(1~3):(2~9); la concentration du prépolymère de résine mélamine urée formaldéhyde préparé est de 1~50wt%.

6. Le procédé d'extinction de sécurité incendie décrit dans l'article I ou IV de la Demande des Droits se caractérise par le fait que la taille des particules de l'agent extincteur à haute rendement est de 50 à 100 μm.

7. Le procédé d'extinction de sécurité incendie décrit dans l'article I de la Demande des Droits se caractérise par le fait que le rapport volumique de la suspension de montmorillonite, du matériau d'extinction d'incendie et du prépolymère de résine mélamine urée formaldéhyde décrit à l'étape S2 est de (1~4):1:(2~6); la concentration de la suspension de montmorillonite est de 0.1~1wt%.

8. Le procédé d'extinction de sécurité incendie décrit dans l'article I de la Demande des Droits se caractérise par le fait que la suspension de montmorillonite décrite à l'étape S2 est obtenue de la montmorillonite naturelle par épluchage ultrasonore dans de l'eau distillée; la puissance du processus de décapage ultrasonore est de 10-50 kHZ et le temps est de 1-2h.

9. Le procédé d'extinction de sécurité incendie décrit dans l'article I-VIII de la Demande des Droits se caractérise par le fait que le débulleur décrit à l'étape S2 comprend, mais sans s'y limiter, un ou plusieurs mélanges de l'heptafluorooctane sulfonate de potassium, le dodécylbenzène sulfonate de sodium, le polydiméthylsiloxane et le n-octanol.

10. L'agent d'extinction à haut rendement, préparé selon le procédé prévu décrit à l'étape S1~S2 du procédé d'extinction de sécurité incendie dans l'une des articles I-IX, comprend la résine de mélamine urée formaldéhyde en tant que matériau de coques et le matériau d'extinction d'incendie en tant que matériaux de noyaux; Les matériaux d'extinction d'incendie comprennent la perfluorohexanone et l'heptafluorocyclopentane.

Drawings

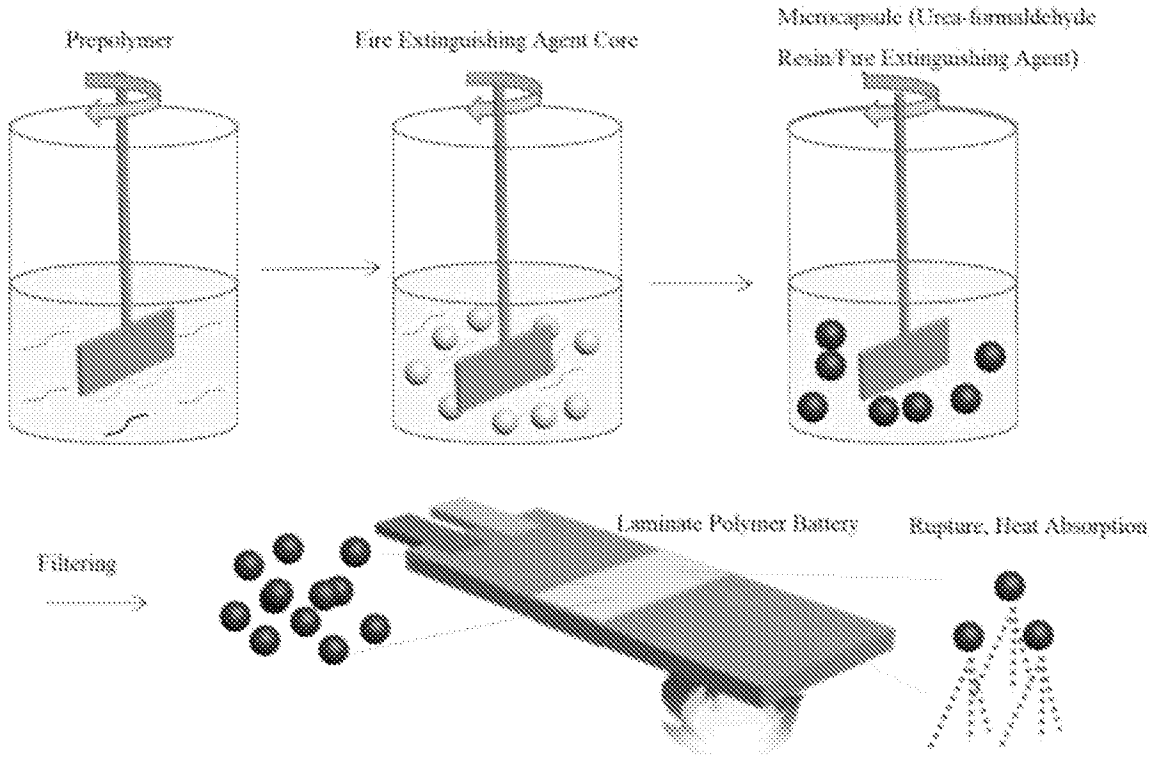


Figure 1

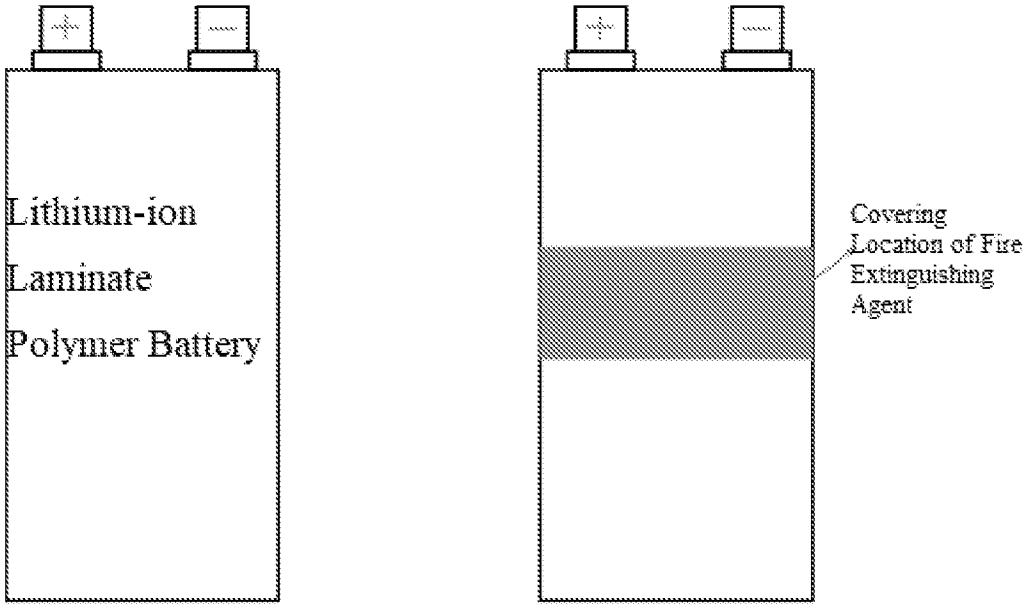


Figure 2