针对 **PFAS** 草案的豁免请求申请书

Application for an exemption request for the draft PFAS

产品名称**:PEM** 电解水制氢膜电极

Product name: PEM water lysis hydrogen film electrode

提交者**:**安徽枡水新能源科技有限公司

Submitted: Anhui Water New Energy Technology Co., LTD

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一、产品描述:

氢能，氢和氧进行化学反应释放出的化学能，是一种二次清洁能源，被誉为“21 世纪终极能源”，也是在全球碳达峰、碳中和的大背景下，加速开发利用的一种清洁能源。氢具有燃烧热值高的特点，是汽油的 3 倍，酒精的 3.9 倍，焦炭的 4.5 倍。氢燃烧的产物是水，是世界上最干净的能源。资源丰富，可持续发展。

质子交换膜电解水制氢是一种新型的氢气生产技术，它利用电解水的原理，通过质子交换膜将水分解成氢气和氧气这种技术具有高效、环保、安全等优点，被广泛应用于氢能源领域。它可以与氢燃料电池耦合，为汽车、船舶等交通工具提供动力。同时它还可以用于工业生产中的氢气需求，如化工、电子、半导体等行业。此外，质子交换膜电解水制氢技术还可以用于储能，将电能转化为氢气储存，以备不时之需。

膜电极作为质子交换膜电解水制氢装置的关键核心部件，对于电解水制氢的性能、效率、寿命和成本起着关键性的作用，一般由质子交换膜（PEM）、阴阳极催化层（CL）和阴阳极多孔传输层（PTL）组成。其中最常用的商业化电解水制氢用质子交换膜（PEM）为全氟磺酸树脂膜（PFSA）。

1. product description:

Chemical energy, released by the chemical reaction of hydrogen and oxygen, is a kind of secondary clean energy, known as "the ultimate energy of the 21st century". It is also a clean energy that accelerates the development and utilization in the context of global carbon peak and carbon neutrality. Hydrogen has the characteristics of high combustion calorific value, which is three times that of gasoline, 3.9 times that of alcohol, and 4.5 times that of coke. The product of hydrogen combustion is water, the cleanest energy source in the world. Rich in resources, sustainable development.

Proton exchange membrane electrolysis from water is a new type of hydrogen production technology, which uses the principle of water electrolysis to decompose water into hydrogen and oxygen through the proton exchange membrane. This technology has the advantages of high efficiency,

environmental protection and safety, and is widely used in the field of hydrogen energy. It can be coupled to hydrogen fuel cells to power vehicles such as cars and ships. At the same time, it can also be used in the industrial production of hydrogen demand, such as the chemical industry, electronics, semiconductor and other industries. In addition, proton exchange membrane electrolysis water hydrogen production technology can also be used for energy storage to convert electricity into hydrogen storage in case of emergency.

As the key core component of proton exchange membrane water electrolysis hydrogen production device, membrane electrode plays a key role in the performance, efficiency, life and cost of water electrolysis hydrogen production. It is generally composed of proton exchange membrane (PEM), Yin-Yang catalytic layer (CL) and Yin-Yang porous transport layer (PTL). One of the most commonly used proton exchange membrane (PEM) for commercial electrolytic water for hydrogen production is perfluorosulfonate resin membrane (PFSA).

二、请求豁免:

我们请求将如上应用了全氟磺酸树脂膜（PFSA）的 PEM 电解水制氢膜电极产品在 PFAS 草案中申请全部豁免。

2. Request an exemption from this item:

We apply for the exclusion of the substances mentioned from the PFAS ban.

三、豁免理由:

【**1**】绿氢产业是欧洲经济增长和就业创造的重要动力

众所周知，欧洲是世界上最早开发和利用氢能的地区之一，也是目前最积极推进氢能发展的地区之一。欧盟委员会于2020年7月发布的《欧洲氢能战略》，是一份关于氢能发展的指导性文件，为欧洲建立整合的氢能市场提供了清晰的愿景和路线图。随后一些欧洲国家在本国层面制定和实施了关于氢能发展的战略性文件，旨在为本国的氢能市场和产业提供一个清晰的目标和路径。这些国家包括德国、法国、荷兰、西班牙、葡萄牙、意大利、奥地利、波兰等。

欧洲在氢能产业领域也取得了重要的成就，主要体现在以下几个方面：

- 电解槽规模：欧洲是全球最大的电解槽市场，占全球市场份额约40%。截至2022年底，欧洲共有约300兆瓦（MW）的电解槽装机容量，预计到2030年，欧洲的电解槽装机容量将达到4000兆瓦（MW）。

- 电解水制绿氢产量：欧洲是全球最大的绿色氢生产区域，占全球市场份额的约50%。截至2022年底，欧洲共生产了约10万吨的绿色氢，预计到2030年，欧洲的绿色氢产量将达到1000万吨。

- 氢能共同市场：欧洲是全球最先建立氢能共同市场的地区，这些项目和倡议涵盖了氢能的生产、储存、运输、分配和应用等各个环节，涉及了多个国家和地区，形成了一些跨国和跨区域的氢能走廊和集群。

- 氢能应用领域：欧洲是全球最广泛应用氢能的地区，工业领域的炼油厂、化工厂、钢铁厂使用绿色氢或低碳氢替代化石燃料，交通领域已有燃料电池汽车、公交车、卡车、火车推广应用，电力领域利用氢储存可再生能源电力，并在需要时释放出来，建筑领域开始使用燃料电池或混合供暖系统，农业领域有农场和温室开始使用氢作为肥料或供暖源。

随着可再生能源电力价格的降低、电解槽效率的提高、规模化效应的显现等因素，绿色氢将逐渐降低成本并提高竞争力，成为欧洲实现碳中和目标的重要手段之一。同时，随着技术标准的统一、基础设施的完善、社会认知的提高等因素，绿色氢将逐渐扩大市场并增加需求，成为欧洲促进经济增长和就业创造的重要动力之一。在此背景下，保障制氢基础设施规模化发展、提升绿氢生产能力，应是毋庸置疑的共识，而在电解水制氢过程中所需的关键材料若受限制，将极大影响欧洲氢能产业的发展前景和机遇。

3. Reason for the exemption:

[1] The green hydrogen industry is an important driver of economic growth and job creation in Europe

As we all know, Europe is one of the first regions in the world to develop and utilize hydrogen energy, and it is also one of the regions most actively promoting the development of hydrogen energy. The European Hydrogen Strategy, released by the European Commission in July 2020, is a guiding document on the development of hydrogen energy, providing a clear vision and roadmap for the

establishment of an integrated hydrogen market in Europe. Subsequently, some European countries have developed and implemented strategic documents on the development of hydrogen energy at their own level, aiming to provide a clear goal and path for their own hydrogen energy market and industry. These countries include Germany, France, the Netherlands, Spain, Portugal, Italy, and Austria , Poland et al.

Europe has also made important achievements in the field of hydrogen energy industry, mainly reflected in the following aspects:

Electroute cell scale: Europe is the world's largest electrolytic cell market, accounting for about 40% of the global market share. By the end of 2022, there is about 300 MW (MW) of electrolytic cell capacity in Europe, and it is expected to reach 4,000 MW (MW) by 2030.

Electrolysis of water to produce green hydrogen production: Europe is the world's largest green hydrogen production region, accounting for about 50% of the global market share. By the end of 2022, Europe had produced about 100,000 tons of green hydrogen, and it is expected to reach 10 million tons by 2030.

Common market for Hydrogen energy: Europe is the first region in the world to establish a common market for hydrogen energy. These projects and initiatives cover the production, storage, transportation, distribution and application of hydrogen energy, involving many countries and regions, forming some trans-national and trans-regional hydrogen energy corridors and clusters.

Hydrogen application field: Europe is the world's most widely used hydrogen region, industrial refineries, chemical plants, steel plant using green hydrogen or low carbon to replace fossil fuels, fuel cell vehicles, transportation, buses, trucks, trains, electricity using hydrogen storage renewable energy electricity, and release in need, construction began to use fuel cells or hybrid heating system,

agricultural farms and greenhouses began to use hydrogen as fertilizer or heating source.

With the reduction of the price of renewable energy electricity, the improvement of electrolytic cell efficiency, and the emergence of scale effect, green hydrogen will gradually reduce the cost and improve the competitiveness, and become one of the important means to achieve the goal of carbon neutrality in Europe. At the same time, with the unification of technical standards, the improvement of infrastructure, the improvement of social cognition and other factors, green hydrogen will gradually expand the market and increase the demand, and become one of the important driving forces for promoting economic growth and job creation in Europe. In this context, it should be a consensus to ensure the large-scale development of hydrogen production infrastructure and improve the production capacity of green hydrogen, and the key materials needed in the process of water electrolysis for hydrogen production If restricted, it will greatly affect the development prospects and opportunities of the European hydrogen energy industry.

【2】全氟磺酸膜（PFSA）在电解水制绿氢中具有不可替代性

PEM 电解水制氢用质子交换膜要求具有高质子传导性、低气体渗透率、高机械强度和结构强度、良好的热和化学稳定性、高耐久性等。全氟磺酸质子交换膜（PFSA）是一种容易操作并具有良好耐候性的多孔膜，具有众多优点，在水处理过程中起着重要的作用。它的主要用途有去离子，吸附，膜分离，催化反应，降解有机物等等。

20 世纪 60 年代，美国杜邦公司开发了全氟磺酸（PFSA）膜，即 Nafion 系列产品。这一产品可以说是质子交换膜发展史上的里程碑，其凭借着优异的化学稳定性、高机械强度，以及在低温和高湿度下突出的离子电导率，使得质子交换膜从实验室走向了商业化。

继杜邦公司以后，日本的旭硝子公司（Asahi Glass）、旭化成公司（Asahi Chemicals），美国的道化学公司（Dow），加拿大的巴拉德公司（Ballard），比利时的苏威公司（Solvay），相继开发出不同结构的全氟磺酸膜。

目前市场上可取得的替代品有磺化聚酰亚胺膜，但是此替代品与全氟磺酸树脂膜（PFSA）比较发现，其机械性能、导电率等劣于全氟磺酸树脂膜（PFSA），仅适用于本工段部分工况，因此属于不完全替代品。同时，全氟磺酸树脂膜（PFSA）的完全替代品必须至少满足拉伸强度（横向/纵向）≥25/25MPa，断裂伸长率（横向/纵向）≥200/200%，杨氏

模量(TD/MD) ≥180/180MPa，尺寸变化率(TD/MD/Z) ≤25/25/25%，质子传导率≥140mS/cm。

根据含氟情况分类，质子交换膜主要包括全氟磺酸质子交换膜、部分氟化质子交换膜、非氟化质子交换膜、复合质子交换膜。其中大部分仍处在研究阶段，市场上应用最为广泛的仍然是全氟磺酸膜，短期内（10年以上）并无合适的可替代产品。

[2] Perluorosulfonic acid membrane (PFSA) is irreplaceable in electrolytic water to produce green hydrogen

Proton exchange membrane for PEM electrolytic water for hydrogen production requires high proton conductivity, low gas permeability, high mechanical strength and structural strength, good thermal and chemical stability, high durability, etc. Perluorinated sulfonate proton exchange membrane (PFSA) is a porous membrane easy to operate and has good weather resistance, which has many advantages and plays an important role in water treatment. Its main uses are deion, adsorption, membrane separation, catalytic reaction, degradation of organic matter and so on.

In the 1960s, DuPont developed a perfluorosulfonic acid (PFSA) membrane, or the Nafion series of products. This product can be said to be a milestone in the development history of proton exchange membrane, with its excellent chemical stability, high mechanical strength, and outstanding ionic conductivity at low temperature and high humidity, making the proton exchange membrane from the laboratory to commercialization.

Following DuPont, Japan's Asahi (Asahi Glass), Asahi Chemical (Asahi Chemicals), Dow Chemical (Dow) in the United States, Ballard (Ballard) in Canada, and Solway (Solvay) in Belgium have developed perfluoronic acid membranes in different structures.

At present, the substitute available on the market are sulfated polyimide membrane, but compared with perfluorinated sulfonic acid resin membrane (PFSA), it is found that its mechanical properties and conductivity are inferior to perfluorinated sulfonic

acid resin membrane (PFSA), which is only suitable for some working conditions of this section, so it is an incomplete substitute. At the same time, the complete substitute of perfluoroplastic resin film (PFSA) must be at least meet the tensile strength (transverse / longitudinal) 25 / 25MPa, fracture elongation (transverse / longitudinal) 200 / 200%, Young's modulus (TD / MD) 180 / 180MPa, the rate of dimensional change (TD / MD / Z) 25 / 25 / 25%, proton conductivity of 140 mS / cm.

According to the classification of fluorine containing cases, proton exchange membrane mainly includes perfluorinated sulfonate proton exchange membrane, partially fluorinated proton exchange membrane, non-fluorinated proton exchange membrane, and composite proton exchange membrane. Most of them are still in the research stage, and the most widely used in the market is still the perfluorinated sulfonic acid membrane, and there is no suitable replacement product in the short term (more than 10 years).

【3】全氟磺酸膜（PFSA）并未有相关证据证明其存在有害性

全氟磺酸膜由硅氧烷(PVDF) 和全氟磺酸(PFS) 高分子两部分组成，在高温下将 PVDF 和 PFS 熔合成一体，形成一种氧化性聚合物膜，改良处理后形成一种带有核磁键，具有多种孔径结构的高分子复合膜。因此，PFS 具有被水驱进入膜体，在空气中氧化，把有机物物理过滤渗透消减，尤其是大分子有机物吸附的特点，水的纯度可以达到 99.95%。

此外，PFSA 质子交换膜的耐候性也比较好。针对温度，酸碱度，氯离子浓度，OTP 等不断变化，而全氟磺酸质子交换膜能够有效抵抗这些影响。

最后，全氟磺酸质子交换膜还具有抗细菌的特点，膜的表面抗细菌性非常高，可以有效降低污染物的滞留量，从而保证水的纯度，而且可以耐受较高的温度，确保水处理过程的稳定，能够在高温状态下保持较长的滤膜寿命。

总的来说，全氟磺酸质子交换膜是一种容易操作，耐候性强，抗细菌，渗透抵抗酸碱度及 OTP 等变化，水纯度高，滤膜寿命长的复合膜，是最常用的商业化电解水制氢用质子交换膜。产品仅应用于工业制氢场所，不与人体产生直接接触，且目前并未有相关证据证明其存在有害性。

[3] This membrane (PFSA) has no evidence of harm

Perluorosulfonic acid membrane is composed of siloxane (PVDF) and perfluorosulfonic acid (PFS). It integrates PVDF and PFS at high

temperature to form an oxidative polymer membrane. After improved treatment, a polymer composite membrane with nuclear magnetic bonds and multiple aperture structures is formed. Therefore, PFS has the characteristics of being driven into the membrane body by water, oxidizing in the air, reducing the physical filtration and permeability of organic matter, especially the adsorption of macromolecular organic matter. The purity of water can reach 99.95%.

In addition, the PFSA proton exchange membrane has better weather tolerance. For temperature, pH, chloride concentration, OTP, and the perfluorosulonic acid proton exchange membrane can effectively resist these effects.

Finally, perfluorinated sulfonic acid proton exchange membrane also has the characteristics of anti-bacteria, the surface of the membrane is very high bacterial, can effectively reduce the amount of pollutants, so as to ensure the purity of water, and can withstand high temperature, ensure the stability of water treatment process, can maintain a long filter membrane life in the high temperature state.

In general, perfluorosulfonic acid proton exchange membrane is a composite membrane with easy to operate, strong weather resistance, bacterial resistance, permeability resistance to pH and OTP changes, high water purity and long filter membrane life. It is the most commonly used proton exchange membrane for hydrogen hydrogen electrolysis. The product is only used in industrial hydrogen production sites, and does not have direct contact with the human body, and there is no relevant evidence to prove that it is harmful.

四、产品优良特性：

我公司应用了全氟磺酸树脂膜（PFSA）的 PEM 电解水制氢膜电极产品，已实现大尺寸批量制备，年产能可达 6000m^2，可加工尺寸活性面积≥5000cm^2。通过超声喷涂、刮涂、直涂等工艺制作，膜电极产品一致性好、耐受性强（衰减率≤5μV/hr），并攻克大尺寸 PEM 电解水膜电极封边技术难题，提升膜电极稳定性和机械强度，

降低电解水制氢装置的装堆难度。大尺寸PEM电解水膜电极生产工艺成熟，可根据客户需求定制催化剂种类、活性面积、封边打孔、扩散层选配等。以技术迭代实现降本提效，助力风电/光伏可再生能源制氢效率提升，有效促进电解槽装机规模扩大、绿氢制造产量提升，并以氢气为媒介打通可再生能源电力在工业和交通等终端领域应用，对于欧洲绿氢产业发展具有不可忽视的推动作用。

Product 5、excellent characteristics:

Our company has applied the resin membrane (PFSA), which has achieved large size batch preparation, with an annual production capacity of 6000m2, and an active area of 5000cm2. Through ultrasonic spraying, scraping, direct coating and other processes, the membrane electrode products have good consistency and strong tolerance (attenuation rate 5 μ V / hr), and the technical problem of large size PEM electrolytic water membrane electrode is solved, the stability and mechanical strength of the membrane electrode are improved, and the difficulty of the water electrolysis hydrogen production device is reduced. Large size PEM electrolytic water membrane electrode production process is mature and can be customized according to customer needs Catalyst type, active area, edge drilling, diffusion layer selection, etc. Implementation with technology iteration authors effect, power wind / photovoltaic renewable energy hydrogen production efficiency, effectively promote the electrolytic cell installed scale, green hydrogen production, and hydrogen as the medium through renewable energy power application in the field of industrial and transportation terminal, for European green hydrogen industry development cannot be ignored.