



4CAIR

为世界提供清洁的空气

PROVIDING
THE WORLD WITH CLEAN AIR

深圳市四清空气技术有限公司



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CITY STATUS

城市现状

击败“空气杀手”雾霾,PM2.5过滤技术亟待升级

To defeat PM2.5, air filtration technology needs to be upgraded

空气污染已经成为所有发展中国家和发达国家面临的危害全人类健康的严峻问题。据世界卫生组织统计,每年大约有超过700万人数的过早死亡(占所有过早死亡的16%)与空气污染有关。而在这700万死亡人数中,有200万人数来于东亚地区。中国癌症中心2018年报告显示,在中国每分钟就有四个人死于癌症,其中肺癌死亡排在第一位,平均每年有78万新增肺癌死亡例。颗粒物形式的空气污染,特别是直径小于2.5微米(PM2.5)的空气污染尤为致命。这些比人类头发直径小40倍的颗粒可以被困在人体肺部或者通过肺部影响其他器官。暴露在这些空气污染的环境中不仅会导致肺癌,还会导致心脏病,中风和其他呼吸道感染。相比之下,每天暴露在发达国家污染严重的地区可能相当于每天吸烟10到20支。气候变化和人口增长会导致极端天气频繁出现;汽车使用量的增加和城市的发展也将使空气污染越来越严重。人类受空气污染影响也成为我们今天必须面对和解决的全球性问题。

Air pollution is an imminent issue facing global human health in both developing and developed countries. The World Health Organization now estimates over 7 million of premature deaths per year (16% of all premature deaths) are linked to pollution. Of these 7 million deaths, 2 million per year are in East Asia. The 2018 report of China National Cancer Center states that lung cancer ranks first in China, with approximately 781,000 new cases every year. And it is estimated four people die of cancer every minute in China. Air pollution in the form of particulate matter, particularly those with diameter under 2.5 microns (PM2.5) is particularly deadly. These particles, 40× smaller than the diameter of a human hair, can be trapped within the human lungs or pass through the lungs to affect other organs. This exposure contributes to not only lung cancer, but also heart disease, stroke, and other respiratory infections. As a comparison, daily exposure to heavily polluted areas in developed nations can be equivalent to smoking over 10 or 20 cigarettes per day. The severity of air pollution is expected to increase as climate change and population growth can result in extreme weather patterns, increased car usage, and increased urban development. As all humans will be affected by air pollution problems, it is a global issue we must address today.

4C NANO TECHNOLOGY

4C纳米技术

空净市场添新成员 对抗雾霾新希望

As a new member in air filtration market, 4C Air brings nano technology to against PM2.5

在市面上,传统的面罩和HEPA过滤器材料都是基于超细纤维的无纺布。这些材料虽然可以有效地防止颗粒物污染,但是由于材料厚度高,它们通常也会伴随着高阻力,并且对于过滤小的颗粒污染(~100纳米)可能也不那么有效。因此一些拥有较低空气阻力或者更好透明度的过滤技术也开始浮现在市面上。例如,运用静电吸附技术可以吸引或排斥大的颗粒物而没有太大的空气阻力,但它对较小的颗粒没有太有效。而且如果这些静电吸附系统处于活动状态,它们会消耗高能量并产生有害的臭氧。另一技术是使用多孔膜过滤(例如花粉筛),这种多孔膜有很好的透明性,但是难以过滤细小颗粒污染。

Traditional facemasks and HEPA-filters are based on microfiber nonwovens. While these materials can be effective against particulate matter pollution, they typically exhibit high resistance due to the high material thickness and may not be as effective against the smallest of particulate pollution (~100 nanometers). Some technologies have emerged as potential air pollution solutions with additional functionality, such as lower air resistance or transparency. For example, while electrostatic adsorption can be used to attract or repel large PM without much air resistance, it is ineffective against smaller particles. If these static-based systems are active, they will utilize high energy consumption and create hazardous ozone. On the other hand, whereas porous membranes (e.g. pollen screens) that rely on using size exclusion can be transparent, it becomes difficult to reliably create pores small enough for PM2.5.

4C Air最重要的科学突破之一是开发出了拥有非常均匀纳米纤维的无纺产品。这些纳米纤维的直径仅为约100纳米,比人类头发的直径小约1000倍,并且直径比商业非织造微纤维小10-100倍(约10倍基重)。这种细小的纳米纤维可以使过滤材料拥有很好的透明性(单独的纳米纤维膜的透射率高达90%)。另外,纳米纤维的高表面积与体积比使得能够过滤极细颗粒物同时保持高透气性。将4C Air的高度均匀的纳米纤维薄膜结合在穿孔或网状材料上可生成很好的微小颗粒过滤窗纱。4C Air可以为传统非织造产品带来更好的过滤效率。

One of the most significant scientific breakthroughs of 4C Air is in the development of highly uniform nanofiber-based nonwoven products. These nanofibers are only ~100 nanometers in diameter, roughly 1000× smaller than the diameter of human hair, and 10-100× smaller in diameter than commercial non-woven microfibers (roughly 10× lower basis weight). As an added benefit, the small size of each fiber results in nonwoven filters that can be optically translucent (with transmittance up to 90% for the nanofiber film alone). The high surface area to volume ratio of nanofibers enable filtration of extremely fine particulate matter while maintaining high air permeability. Incorporating 4C Air's highly uniform nanofiber film on perforated or mesh materials creates a particulate matter filtering window screen. Addition of 4C Air to traditional nonwoven products results in high efficiency and fine particulate matter filtration.





ABOUT 4C AIR

关于四清

深圳市四清空气技术有限公司（以下简称“深圳四清”）是一家专注于纳米纤维空气过滤技术和材料研发的高新技术企业。深圳四清所销售的4C Air系列产品主要聚焦于个人以及行业领域的雾霾过滤以及空气质量改善。相对于传统空气过滤材料，4C Air公司所研发产品具低阻高效的特点，在口罩、纱窗、空调、空气净化器、新风系统等都有广泛应用。

深圳四清作为空气联盟的会员单位，同时也是防雾霾窗纱标准的起草单位之一，公司产品在空气环保领域的划时代意义，获得了政府及各界的大力支持。目前4C Air正在积极开发供个人和家庭使用的产品，同时探索HVAC、洁净室和医疗应用过滤，不久相关技术将会发布。

Shenzhen 4C Air Technology Co., LTD. is a high-tech start-up focusing on the research and development of nano-fiber air filtration technology and materials for personal and industrial use. Compared with traditional air filtration materials and methods, 4C Air's nanofiber materials, which exhibit low air resistance and high filtration, can be integrated into particulate masks, window screens, HVAC systems, and air purifiers.

Shenzhen 4C Air Technology Co., LTD. is a part of the Clean Air Alliance of China, as well as a contributing editor to the Anti-PM2.5 Window Screen Standard. Currently, 4C Air is developing applications for personal and household use, while exploring HVAC, clean rooms, and medical filtration.



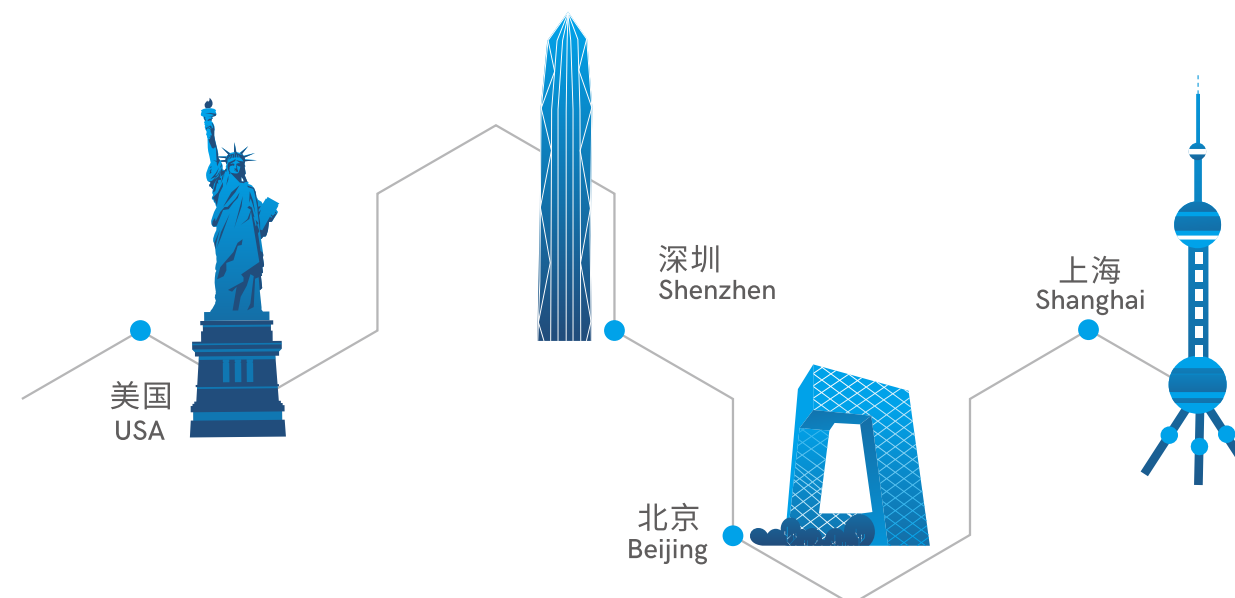
源自硅谷技术，立于深圳智造 为改善空气而来

Silicon Valley Technology



4C Air由斯坦福大学的朱棣文教授和崔屹教授创立于2015年，总部兼研发中心位于美国硅谷（美国加利福尼亚州桑尼维尔）。公司拥有一支技术精湛的科学家和工程师团队，致力于开发最有效的空气污染解决方案。4C Air在中国北京、上海设有销售办事处。

Founded in 2015 by Professors Steven Chu and Yi Cui of Stanford university, 4C Air is headquartered in Silicon Valley (Sunnyvale, California, USA). Along with a team of skilled scientists and engineers, 4C Air is dedicated to developing effective air pollution solutions. Additionally, sales offices are in Beijing and Shanghai, China.



Yi's News

关于崔屹教授的新闻报道

At 28, Cui was named recipient of the "2004 World Top 100 Young Innovator Award" by MIT Technology Review. He was awarded \$10 million in research funds for being one of the top 12 scientists selected around from the world for the "2008 King Abdullah University of Science and Technology (KAUST) Investigator Award". His awards also include the "2010 Wilson Prize" from Harvard University, and the "2013 IUPAC Distinguished Award for Novel Materials and Their Synthesis".

—— China Daily

28岁时,崔屹教授获得“麻省理工学院技术评论”杂志组织授予的“世界顶尖青年发明家”称号。2008年,他获得“阿卜杜拉国王科技大学 (KAUST) 研究员奖”,并且被选为世界十二大科学家之一,获得了1000万美元的研究经费。他的奖项还包括哈佛大学的“2010年威尔逊奖”和“2013年IUPAC新材料及其合成杰出奖”。

——中国日报

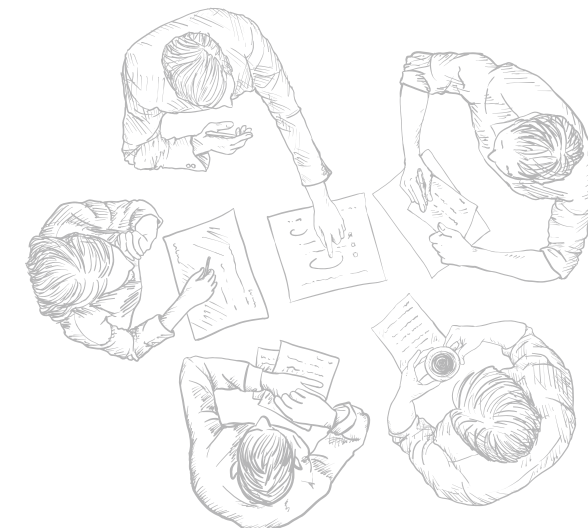
Testing their (Dr. Cui's lab) invention on a bad air day in Beijing last summer, the researchers found that it captured nearly 99% of particulates (dust, soot and other particles that can harm the lungs) while maintaining 77% transparency. After measuring absorption rates, the scientists estimate that, in heavy pollution, such a screen could continue pulling particles out of the air for more than 300 hours.

—— Wall Street Journal

去年夏天,研究人员在北京一个空气质量不佳的日子里对崔屹教授实验室的发明进行了测试,发现该发明过滤了近99%的颗粒物(灰尘、煤烟和其他可能危害肺部的颗粒),同时保持了77%的透明度。在测量了吸收率之后,科学家们估计,在严重污染的环境中,这样的过滤材料可以持续过滤空气中的颗粒物多达300多个小时。

—— 华尔街日报

A TALE OF TWO GIANTS 创始人的故事



美国斯坦福大学终身教授
Professor, Stanford University, USA



美国前能源部长、诺贝尔奖获得者
Former U.S. Secretary of
Energy and Nobel Prize Winner

崔屹教授为公司首席科学家,致力于纳米材料领域的研究,现任美国材料学会和英国皇家化学会会士,被路透社评为“世界排名第一”的材料学家;朱棣文教授曾任美国科学院院士、奥巴马政府美国能源部长,1997年荣获诺贝尔物理奖。

朱棣文教授深知创造高科技产品对当前环境危机的重要性,他的想法得到了斯坦福大学崔屹教授的赞同。崔教授拥有42项专利,为纳米技术、材料科学、能源和环境科学提供技术解决方案。2015年朱教授和崔教授共同创建4C Air,组建了一支由技术精湛的科学家和工程师组成的研发团队,致力于开发最有效的空气污染解决方案。其专为人和家庭使用而设计的尖端高科技产品,HVAC过滤、洁净室和医疗应用等将于2019年发布,目前都受到消费者的高度期待。

Professor Yi Cui is dedicated to the research of nanomaterials. He is a Fellow of Materials Research Society and the Royal Society of Chemistry. Professor Steven Chu is a member of the U.S. National Academy of Sciences and former Secretary of Energy under President Obama. He was awarded the Nobel Prize in Physics in 1997.

Professor Chu is aware of the importance of creating high-tech products for the current environmental crisis. These sentiments are echoed by Professor Yi Cui (Stanford University), whose 42 patents enable nanotechnology solutions for energy and environmental applications. Together at Stanford, the two developed the underlying technology of 4C Air. Seeing the promise of the new technology as well as the dire air conditions all over the world, Professors Chu and Cui would go on to found 4C Air in 2015.

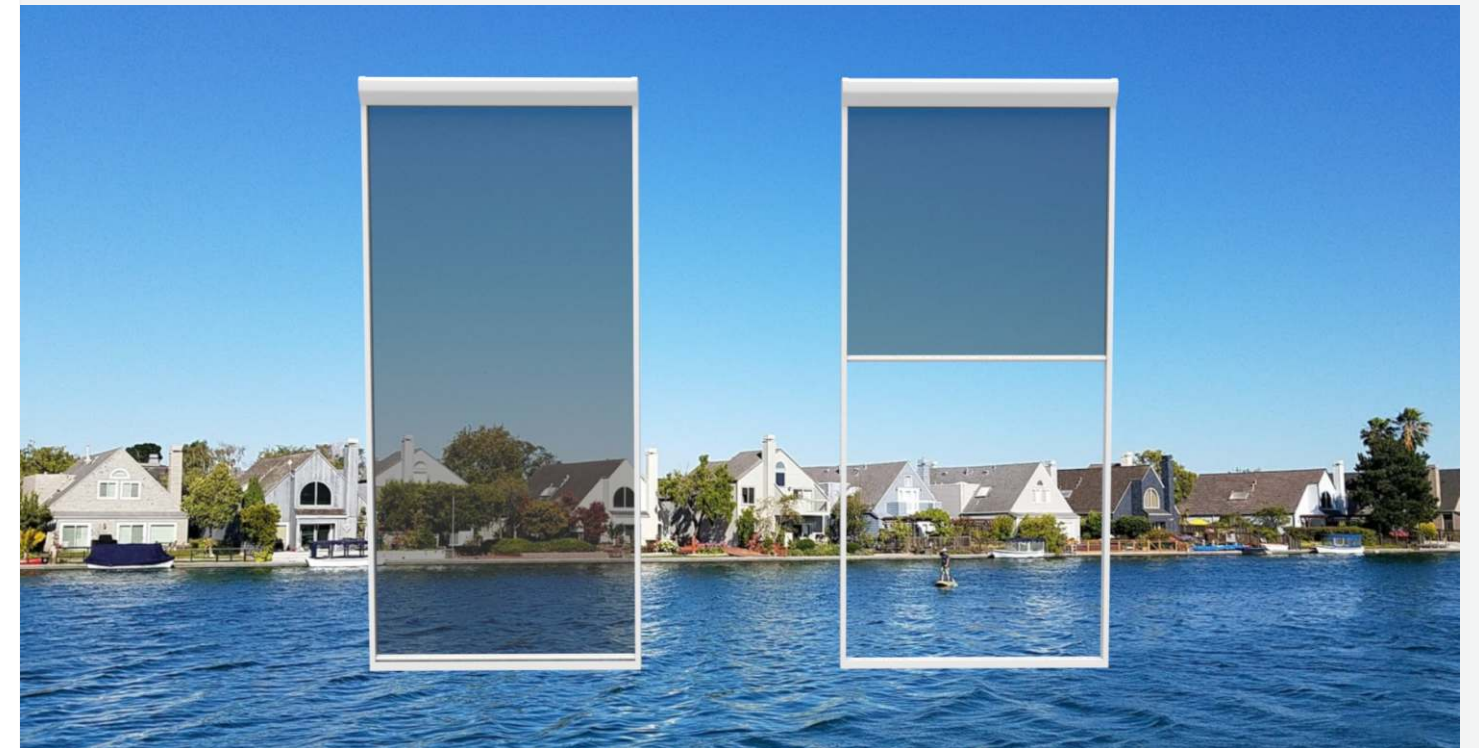


4C Air 高性能防雾霾口罩 纳米纤维, 高效过滤

4C Air high performance anti-PM2.5 mask
Nanofiber, high filtration efficiency

通过将高端纳米纤维技术整合到传统的无纺布面罩中, 4C Air的防雾霾口罩能够在高空气污染环境中提供高性能的个人防护。这些防雾霾口罩有效地使用非织造材料来过滤较大的颗粒, 与此同时内层的纳米纤维可以捕获最小, 也是最危险的颗粒。另外, 通过使用纳米纤维作为过滤介质, 这些防雾霾口罩能在拥有舒畅透气性的同时保持非常高的过滤效率。4C Air提供符合国际公认标准的高效率的防雾霾纳米口罩, 如N90和N95。通过优秀的设计和人体工程学设计, 4C Air希望为受空气污染的人群提供舒适, 高科技的洁净空气解决方案。

By integrating our nanofiber technology into traditional non-woven based facemasks, 4C Air's products can provide high performance personal protection against heavy pollution. These facemasks effectively use nonwoven materials to filter larger particles while the nanofibers inside can trap the smallest and most dangerous particles. In addition, by using nanofibers as the filtration media, the air resistance of these masks is low while retaining a high filtration efficiency. 4C Air offers nanofiber facemasks that meet internationally recognized standards, such as N90 and N95. By combining excellent design and ergonomics, 4C Air hopes to provide you with a comfortable and high-tech solution for clean air.



4C Air纳米科技纱窗 4C Air Nano Technology Screens

通过将纳米纤维与穿孔或网状材料相结合, 4C Air开发了一种新型创新的PM2.5过滤窗纱, 它具有:

99%

• 高达99% 的
PM2.5过滤效率



• 高光学透明度



• 低空气阻力

- 该纱窗非常适合春季和秋季的通风, 另外它也是很好的花粉过滤器。不过当空气污染指数达到高污染或危险污染水平 (AQI>200) 时, 建议关好门窗不使用该产品。
- 微小颗粒过滤效率是通过TSI标准的过滤器测试仪8130A测定, 额定为0.3微米颗粒 (效率为90%)。

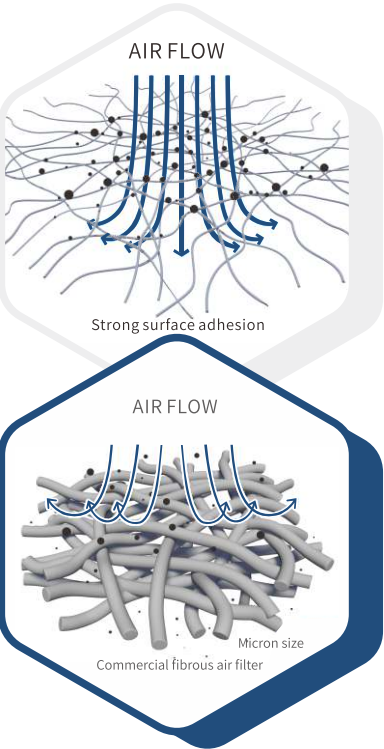
4C Air Window Screen

- By integrating our nanofiber with perforated or mesh based materials, we have developed a new and innovative PM2.5 filtering window screen which has:
 - Up to 99% efficiency for particles of 2.5 microns
 - High optical transparency · Low air resistance
- The filter is ideal for spring and fall ventilation, as it can also be used as a pollen filter. The product is not recommended to be used during high or dangerous pollution levels (AQI>200), when windows should be closed.
- Efficiency is determined using TSI's standard CertiTest Filter Tester Model 8130A, rated for 0.3 micron particles (90% efficiency).



4CNano过滤技术 空气净化新希望

4CNano Filtration Technology New Hope for Air Purification



4CNano 过滤材料系列

4CNano filter material series

- 新型纳米纤维过滤系列，独家专利。
- 纤维直径可控制在50-500纳米区间，产品克重可控制在5 g/m² 以下。
- 透光性好，能在高效率的同时，保持低阻力。
- The new nanofiber filtration series is patent pending.
- The fiber diameter can be controlled in the range of 50-500 nm, and the basis weight can be below 5 g/m².
- The nanofiber material can maintain high light transmittance, low resistance, and high efficiency.

微米级纤维材料过滤

Micron fiber material filtration

这种材料通过物理过滤和吸附的双重作用，来过滤气流中的颗粒物。纤维直径较粗，通常在2微米到30微米之间。这种材料的特点：材料较厚，无透光性，气体阻力和过滤效率不能两全。一般而言，微米级过滤材料克重大于 50 g/m²。

Microfibers filter use physical filtration and adsorption to filter out particles. The fibers are relatively large in diameter and are typically between 2 and 30 microns. These materials are typically thick, opaque, and cannot maintain high filtration efficiency while having low air resistance. In general, micron-sized filter materials have a basis weight greater than 50 g/m².

4CNano过滤原理

4CNano filtration principle

静电纺丝是一种纤维生产方法，其通过控制电场，来拉伸聚合物溶液或聚合物熔体的带电丝束，得到约百纳米直径的纤维。

静电纺丝由于受静电场强度和溶液挥发速度等限制，工业化难度极高。所以，规模化静电纺丝，并将其成功使用在空气过滤应用中，是材料学难题之一。

Electrospinning is a process where a large electric field can be used to draw fibers from a polymer solution or melt. The high strength of the field can form nanofibers, with fiber diameter around 100 nm.

Successful electrospinning relies on controlling the large electric field and solvent vaporization rates, making the scale-up of the process difficult. 4C Air has solved these problems and achieved a commercialized system for electrospinning nanofibers.

空气过滤的机理为：惯性效应、拦截效应、扩散效应以及静电效应。

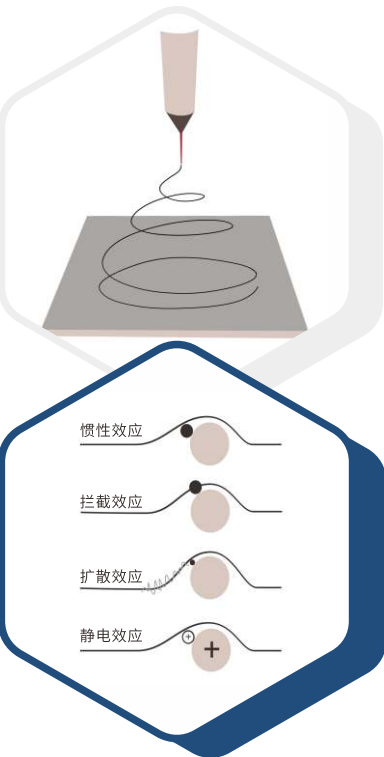
纳米材料能显著增进过滤效率的原因包含、且不限于：

1. 纳米纤维的孔径分布均匀，平均孔径小。
2. 颗粒物粒径和过滤纤维直径相仿，能够大幅度增加拦截效应。

Air filtration relies on particles becoming trapped in the filtration media. This is through the following effects: inertial, interception, diffusion, and electrostatic adsorption.

Nanomaterials can improve the filtration efficiency as:

1. Nanofibers form uniform pore size distribution and small average pore size.
2. The particles are closer in size to the diameter of the nanofibers, which can greatly increase the interception effect.



阻挡空气污染的卫士 4CNano出色表现

Guard against air pollution 4CNano outstanding performance



纳米级纤维材料过滤

克重(< 5 gram/m²)

100% 纳米 (纤维可控直径50 to 500 nm)

纤维均匀分布的过滤网

优异的透光性能

高过滤性能、低空气阻力

专利保护，规模生产

顶尖研发团队，推进技术革新

Nanofiber filtration

Basis weight < 5 g/m²

100% evenly distributed nanofibers (with controllable diameter from 50 to 500 nm)

High light transmittance

High filtration efficiency, low air resistance

Patent pending, scalable production

Skilled R&D team for future product development

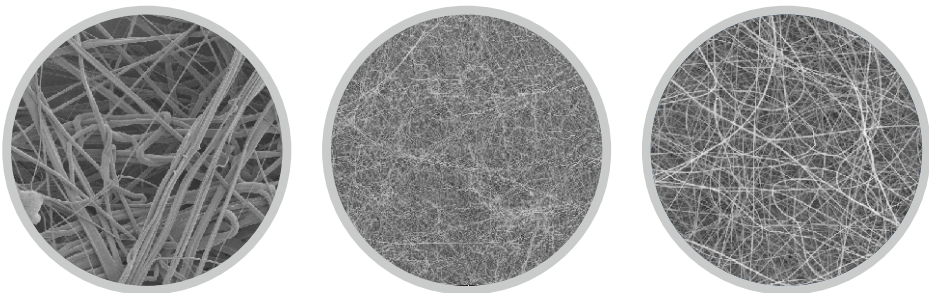
纤维直径

Fiber diameter

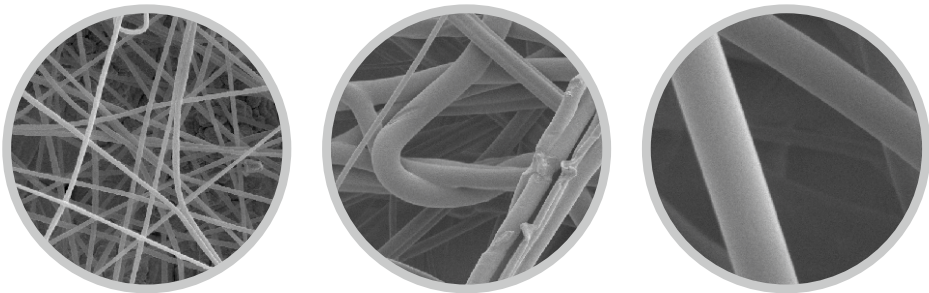
100% 纳米纤维，可以通过控制纺丝和后处理工艺，控制材料的透光度。

By controlling the electrospinning and post-processing techniques, the transparency can be tuned.

4CNano

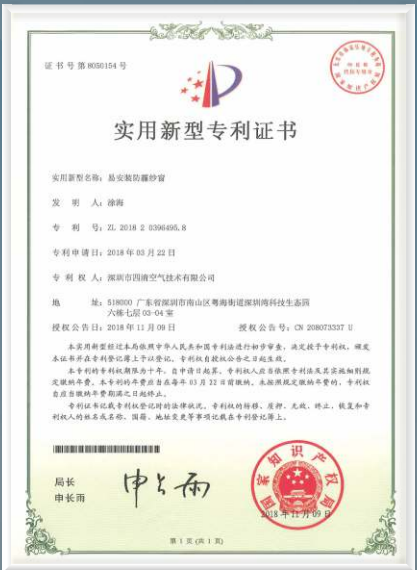
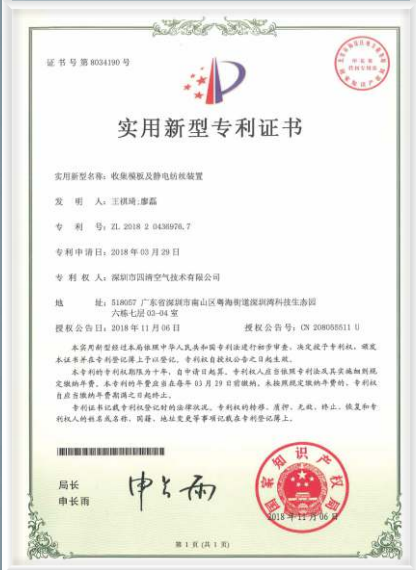


Meltblown



专利保护，规模生产
Patent protection, scale production

4C Air 获得国家各类专利证书。
4C Air has obtained various national patent certificates.





满怀憧憬,展望未来

Full of hope, looking to the future

我们为改善人们生活的空气环境而来,依托先进、专业的空气过滤技术,致力为世界提供清洁的空气;

在过硬的技术与研发实力的背景下,我们秉承客户优先为导向,不忘初心,砥砺前行,持续为客户提供可靠的产品以及专业满意的服务;

我们以改善人们呼吸环境为己任,将持续致力于世界生态环境尤其是空气净化领域的研究,为解决“发展与环境保护”的矛盾提供可行性方案,助力生态环境绿色发展,为社会提供清洁的空气。

4C Air uses innovative and advanced filtration materials to improve the life of people through clean air. With excellent technology and R&D capabilities, 4C Air is committed to providing customers with reliable products as well as professional service.

The development and industrialization of the growing world comes with many environmental challenges, among them poor air quality. In order to come up with a solution for these times, 4C Air was founded to provide the world with clean air.

