

Multilayer Multifunctional Nasal Filter

IITM Technology Available for Licensing

Problem Statement

- Air pollution causes **respiratory & cardiovascular diseases**, due to the **exposure to particulate matter PM2.5**, increasing the demand of effective filtration solutions.
- Existing filter technologies face a **challenge** in simultaneously improving **filtration efficiency** and air permeability and to create efficient filtration systems that **balance high dust removal with low air pressure drop, using nanofibers**. Striking a balance is a concern.
- Indian urban environments research indicates a **distinct charge distribution** in dust particles.
- Hence, **innovative solutions are required** to face this **unique filtration challenge** and to address all the above mentioned issues.

Technology Category/ Market

Categories: Environmental Engineering | Micro & Nano Technologies

Industry: Nasal Filters, Air Quality & Filtration, Healthcare, Environmental Technology, Nano Technology, Nano-filters, Protective Equipment

Applications: Health & Safety, Face masks, Air purifier, quality monitoring & data collection

Market: The global Nasal Filter market was valued at **USD 6.01 Million in 2019**, and is projected to reach **USD 8.96 Million by 2026**, growing at **5.9% CAGR** from 2019 to 2026.

Technology

The present invention discloses an improved **nasal filters** designed to **improve the filtration of particulate matter below 10 μm in size**, focusing on **PM2.5**.

The **Multilayer Multifunctional Nasal Filter** is designed using **multilayered molecularly functionalized nanofibers** wherein, **PAN nanofibers** are created by **electrospinning** followed by **chemical treatment to induce positive charges**, while **PS nanofibers** are similarly treated to **induce negative charges** for enhanced filtration of particulate matter.

FIG. 1 illustrates a Schematic diagram of the arrangement of functionalized nanofibers that captures particulate matter.

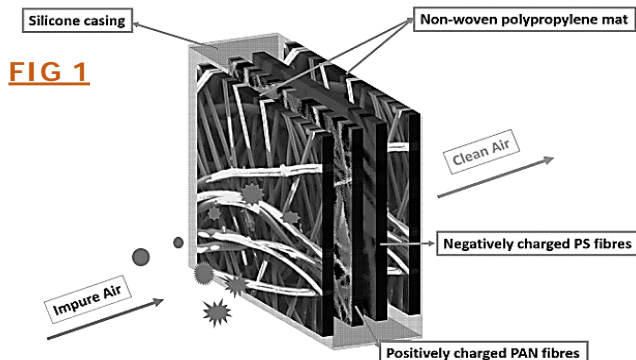
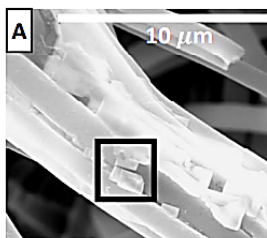
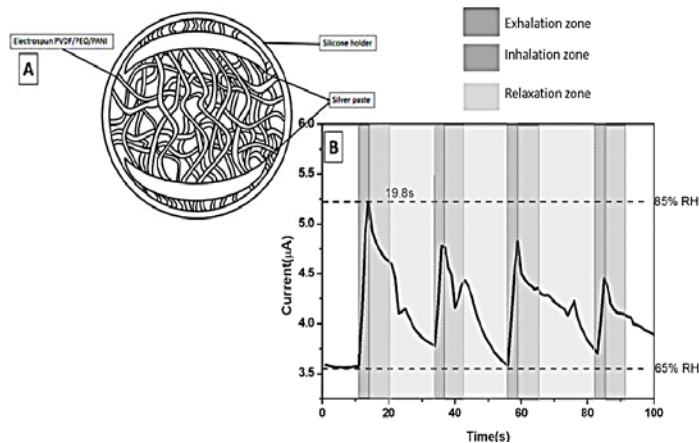


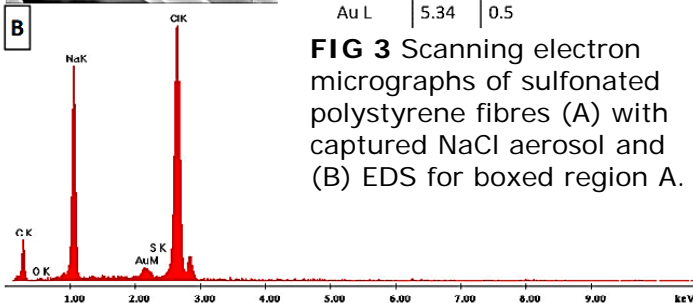
FIG 1

FIG 2 (A) is a schematic representation of the humidity sensor which can be incorporated within the nasal filter. **FIG 2(B)** illustrates the plot of current vs time in the presence of humidity.



Element	Wt%	At%
C K	43.07	65.65
O K	1.06	1.22
Na K	23.36	18.6
S K	0.19	0.11
Cl K	26.98	13.93
Au L	5.34	0.5

FIG 3 Scanning electron micrographs of sulfonated polystyrene fibres (A) with captured NaCl aerosol and (B) EDS for boxed region A.



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Key Features / Value Proposition

> Industrial Perspective:

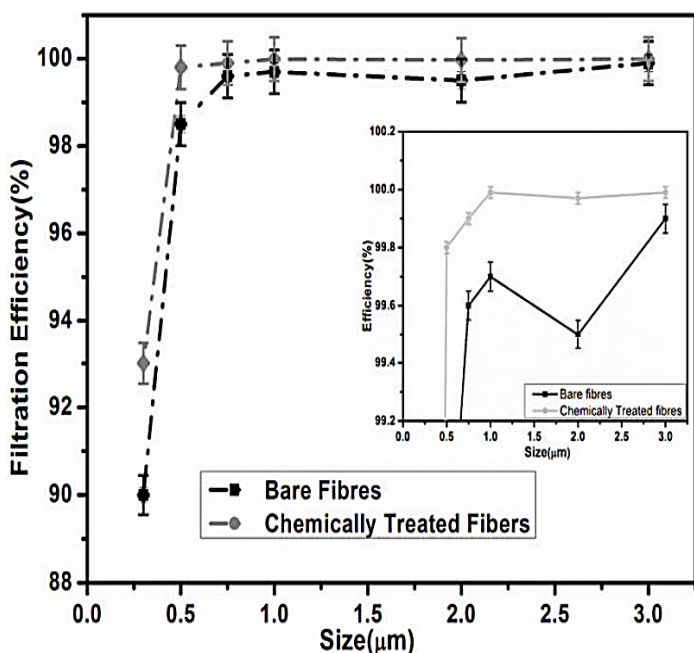
- **Better air quality & productivity** for versatile industrial application, including application within the **disposable nasal plug filters**.
- **Tailored electrospinning production** for Workforce health improvement and **reduced absenteeism** by reduced pollutant exposure.

> User Perspective:

- Used as standalone **face masks** with effective filtration, customized & comfortable **Snug nose nostril fit for ease of use**. Integration to various protection devices as it **provides Comprehensive protection** from particles with different charges.

> Technical Perspective:

- It improves inhaled air quality with **99%** filtration efficiency for **PM2.5**, where the filter gives **comfortable & customized fit**.
- Multi-layer structure with **distinct charges & non-woven mats** for **superior filtration**.
- Potential for metallic **nanobrush deposition on conducting fibers**.
- Incorporation of functional materials (**Al₂O₃, SiO₂, MgO, Fe₂O₃**) during electrospinning for enhanced charge and filtration.
- The beta-cyclodextrin (**βCD**) is incorporated into **PVDF-PEO/PANI composite**, making them **humidity sensors** that enhances the **rate of humidity** adsorption & desorption during respiration for **breath analysis**, valuable for **air quality & health research**.



The design comprises of the following layers, in the direction of airflow:

-An external substrate layer made of spun-bonded nonwoven polymer mat facing outside of the nose.

-The first intermediate layer made of nanofibers with molecularly induced positive charge.

-The second intermediate layer made of nanofibers with molecularly induced negative charge.

-An internal substrate layer made of spun-bonded nonwoven polymer mat facing inside of the nose.

FIG 3 illustrates Filtration efficiencies of bare electro-spun mat and their chemically treated analogues. The expanded region is in the inset.

TRL (Technology Readiness Level)

TRL- 4, Validated in Lab

Research Lab

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Intellectual Property

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