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IIT M develops nano-coated filter for healthcare workers

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Indian Institute of Technology Madras Researchers have developed a nano-coated filter media for healthcare workers treating COVID-19 Patients. This filter has applications not only in healthcare but also has defence applications and other places where air filtration of submicron particles is required

This nano-coated filter media has been fabricated by a nylon-based polymer coating on cellulose paper and was developed through the electrospinning process. The coating properties are optimized for efficient removal of sub-micron sized dust particles in the air.

The nano-coated filter media is in the process of being field tested in practical applications. Upon validation through field trials, it will be recommended for bulk manufacturing through industry collaborations.

This pioneering work is funded by Defence Research Development Organisation (DRDO) for defence applications and due to its high potential for the need of the hour, it is repositioned in health care applications.

Highlighting the unique aspects of the nano-coated filter media, Prof. K. Arul Prakash, Department of Applied Mechanics, IIT Madras, said, “The nano-coating fabricated through the electrospinning process have fiber diameter less than 1 micron and can be positioned according to the need to enhance surface/depth filtration for healthcare workers or public responders. This novel filter with multiple nano-coating have capabilities to filter particles of the order of one micron size, which is a remarkable achievement.”

This project was a collaborative effort with faculty from various departments of IIT Madras including Prof. Raghuram Chetty from Department of Chemical Engineering and Prof. Saravana Kumar from Department of Engineering Design.

Further, speaking about the applications in Defence, Prof. K. Arul Prakash added, “Nano-coated filter media have much better reverse cleanability behaviour resulting in an extended service life period of air filters providing prolonged working hours for armoured vehicles. This will save a huge cost for defence applications where the filters are currently imported from developed countries.”

The Practical Applications of this nano-coated filter media include:

- Face masks with an enhanced particle filtration efficiency,
- Respirator devices,
- Air purification system in operation theatres of hospitals,
- Cabin air filters for the comfort and health of air passengers,
- Air filters for the armoured vehicle engines,
- Computer hard disk drive filters, and
- Pneumatic equipment

PROJECT CURRENT STATUS

The current status of project is that the researchers are trying to optimize the coating parameters of nanomaterials for bulk manufacturing at an affordable cost and testing the antiviral properties for broader utilization in various applications. Also, attempts are being made to develop composite nano-coated filter media having more than one nanomaterial coating with the possibility of manufacturing multi-layered masks.

Various characteristics of the nano-coated material such as permeability (a measure of flow-through media), coating thickness, and mechanical strength have been measured. The optimized nano-coated filter media has been developed using computer tools and validated with experimental results.

An increased filtration efficiency for submicron size dust particles of the order of 0.25 microns with a marginal increase in pressure drop is a notable achievement through this technology. The filtration can be further improved with multilayer nanomaterial coating. The nano-coated filter will not only be restricted for health care and defence applications but, in other places where air filtration of submicron particles is required. The computer simulation methodology adopted for the creation of the structure of the nanocoated filter media is also a novel development in this work.