

Executive Summary



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1. Title of the Project: Next generation filtration devices for protection of environment and health

2. Date of Start of the Project: 01 February 2019

3. Aims and Objectives:

- To develop large size mechanically stable, biodegradable filter media with high filtration efficiency at reduced pressure drop based on nanofibres as an alternative to existing filter media with an aim to reduce power consumption and promote wider usage.
- To develop cost effective filtration devices, such as window screens, industrial airconditioning & air-circulation filters, industrial emission control filters, vehicle cabin filters, antimicrobial filters for hospitals/homes based on the above nanofibre media to protect patients from allergens and bacterial infections and help reduce impact of air pollution on health of industrial workers and general population.

4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc)

Some of the major achievements of the project are as follows:

- a) Rheology of the biopolymers selected was not appropriate for spinning because of low elasticity so the rheology was modified using Boger fluid concept. Also it was observed that single solvent system was not suitable for spinning so was replaced by multi solvent

system. Nanofibres had poor adherence to filter substrate so various techniques were utilized for adhesion like treating substrate with binder, addition of binders to substrate etc.

b) We have already incubated a company Nanoclean Global Private Limited, at IIT Delhi and already launched products viz. nasofilter (filters that can be worn on nostrils for protection from 10 and 2.5 μm), window screens, and AC filters. The major limitation is the nanofibre manufacturing machine. The currently available commercial electrospinning machines are unable to deposit nanofiber uniformly over a wide substrate. We have developed a process for uniform deposition of nanofibres continuously on a textile substrate was developed at the lab scale and we plan to develop a pilot machine for electrodeposition of nanofibers continuously and uniformly over a textile substrate.

c) We have received funding under Uchatar Avishkar Yojna in 2019 for a proposal on Nano respiratory Nasal filters in collaboration with our start-up company NanoClean Global Pvt Ltd.. The project is aimed at improving the current product line by improving nasofilter design and developing filtration analyser suitable for our products. The funds under the project were used to design an instrument in-house to accurately evaluate the pressure drop of the filter media being developed. This system could be used to test pressure drop for flow rates ranging from 1 LPM to 85 LPM on any sample.

d) We received funds from DST under a **special SERB proposal call for Covid-19**. In addition to this Our startup company NCG Pvt Ltd received funding from DST under the **Centre for Augmenting WAR with COVID-19 Health Crisis (CAWACH)** scheme and from **Technology Development Board** for the development of FFP2 grade masks

e) A set up for testing the efficiency of the filter media with zero leakage was developed.

f) We were successful in developing high efficient surgical masks and FFP2 grade masks under the trade name "Nasomasks". They show high filtration efficiency with low pressure drop compared to the other masks available in the market.

g) In addition to this we have developed antiviral coating using our N9 Blue nanosilver. N95 graded masks have been treated with the formulations developed and good results have been obtained

h) We in collaboration with Maulana Azad Medical college studied the effect of various disinfectant-treatments on structure and properties such as efficiency and pressure drop of FFP2 grade masks. The samples were treated with different cycles (1,3,5 cycles) of H_2O_2 , UV and Soap and their effect was studied. It was observed that the damage observed with the UV treatment is less apparent than that of the H_2O_2 treatment. While there was a clear damage to the structure is observed right from the first cycle of the soap treatment

5. Concluding remarks

We are currently working on the anti viral coatings developed using N9 Blue nano silver. Till now different formulations of N9 blue silver have been prepared and tested for their activity. Further effort is directed at upscaling of the formulations. We have obtained significant results to move towards our goal of preparing masks/PPE with antiviral nanocoatings. We would also use N9 blue nanosilver to derive complexes or nanocomposites with other metals such as Zn, Cu and eventually applying them on PPE/masks and check efficacy. In addition to this We also plan to design and develop self-cleaning filter media combining our nanotitania technology for degrading VOC pollutants or waste water treatment and develop filter media with capacity to absorb pollutant gases, such as volatile aromatic compounds, using the technology of metal organic framework (MOFs) being developed by us at IIT Delhi