



UNIVERSITY OF
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Chemical Modification of biomass Fibers for Air Filtration



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Pollution

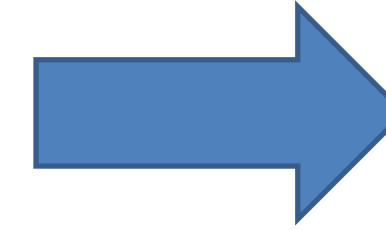
Sources of Pollution

❑ Outdoor

- Fossil fuel
- Chemical Waste

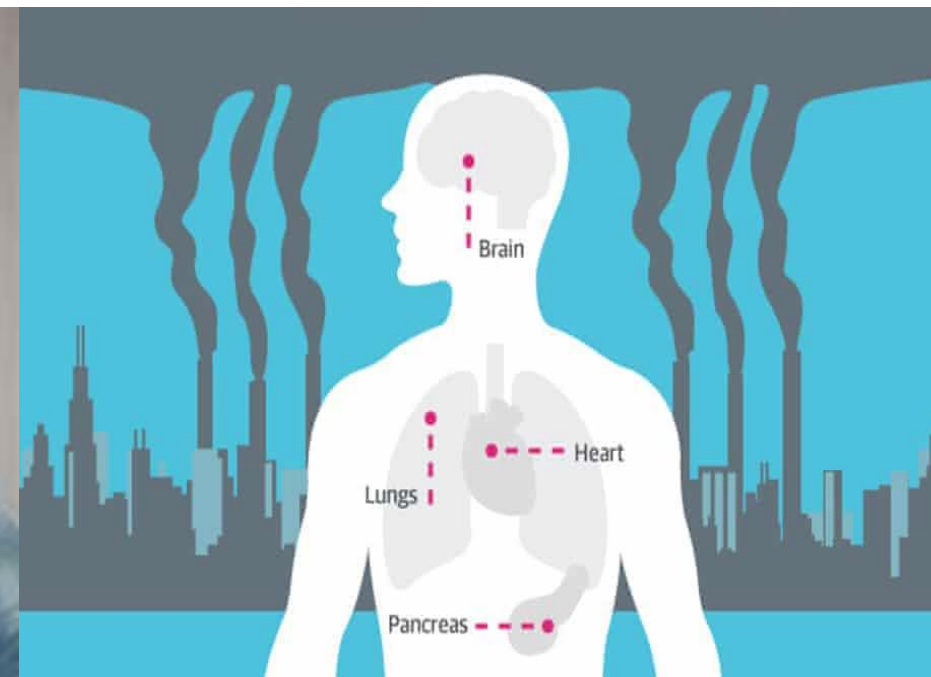
❑ Indoor

- Cigarette Smoke
- Dust and dust mites
- Cleaning products
- Natural gas



Issues and Health Problems

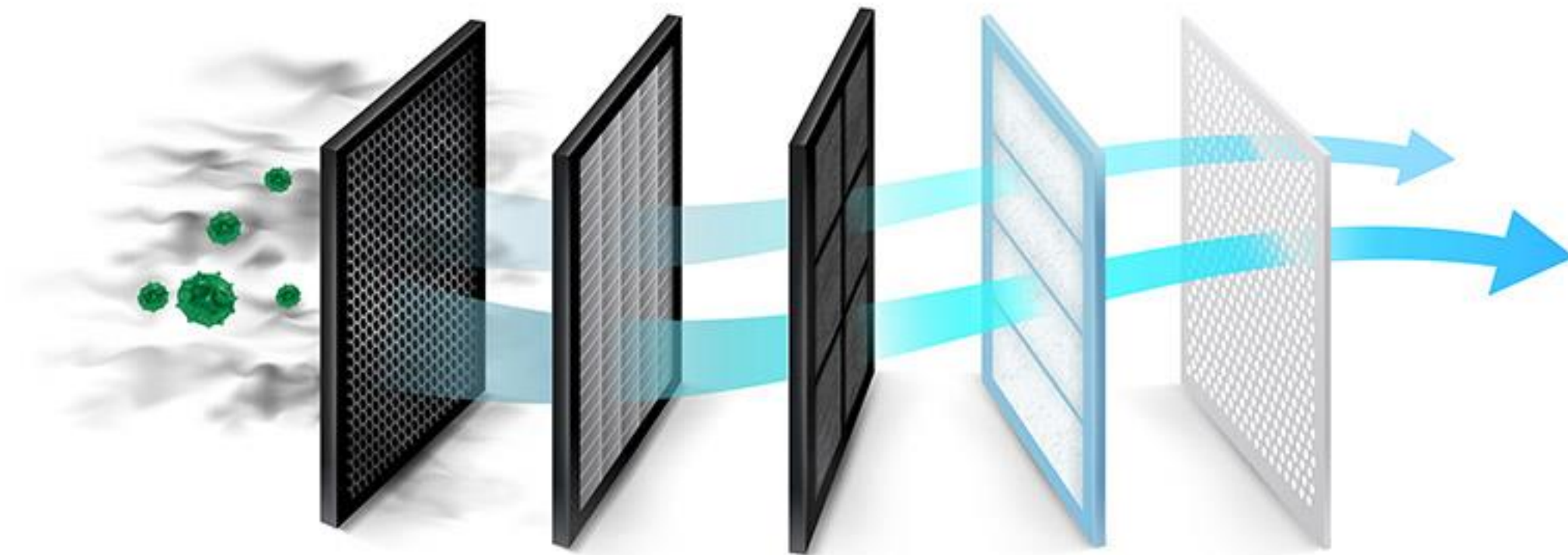
- Lung cancer
- Heart diseases
- Acute and chronic respiratory diseases
- Stroke



Filters

Filter types

- High-efficiency particulate air (HEPA)
- Porous filters
- Fibrous filters
- Activated carbon filter



Fibrous filters

Natural fibers

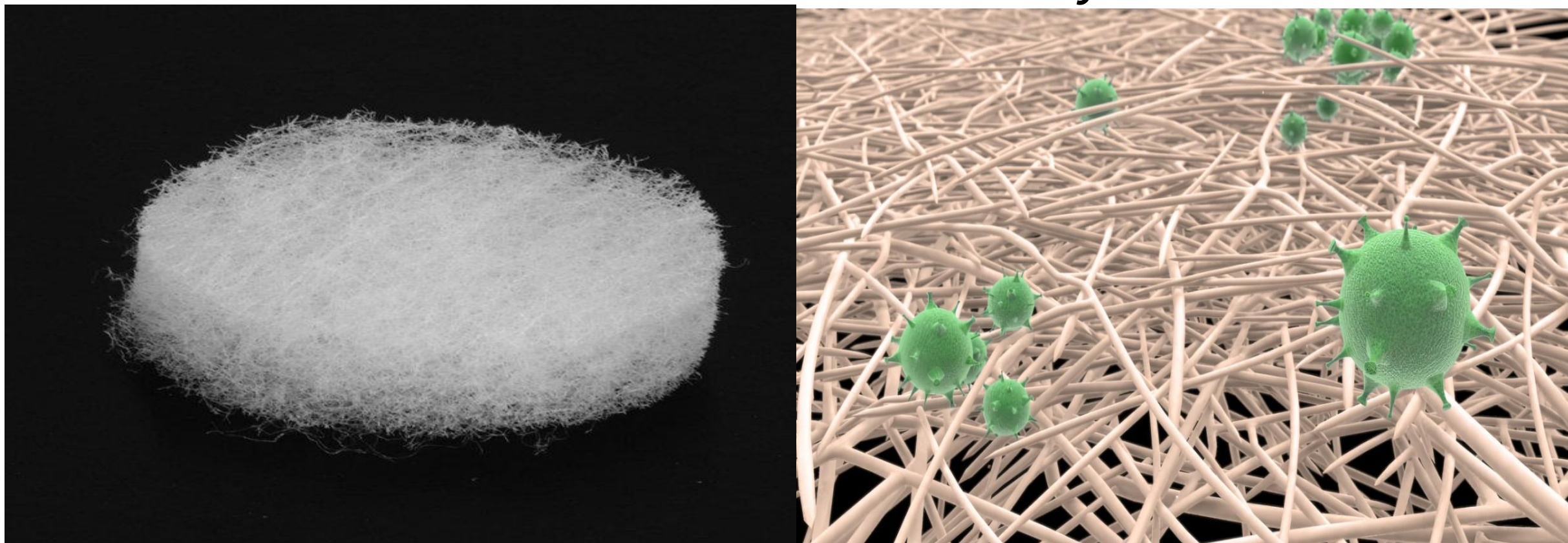
- Cotton
- Silk
- Wool

Synthetic fibers

- Glass fibers
- Polypropylene
- Acrylic
- Polyamide

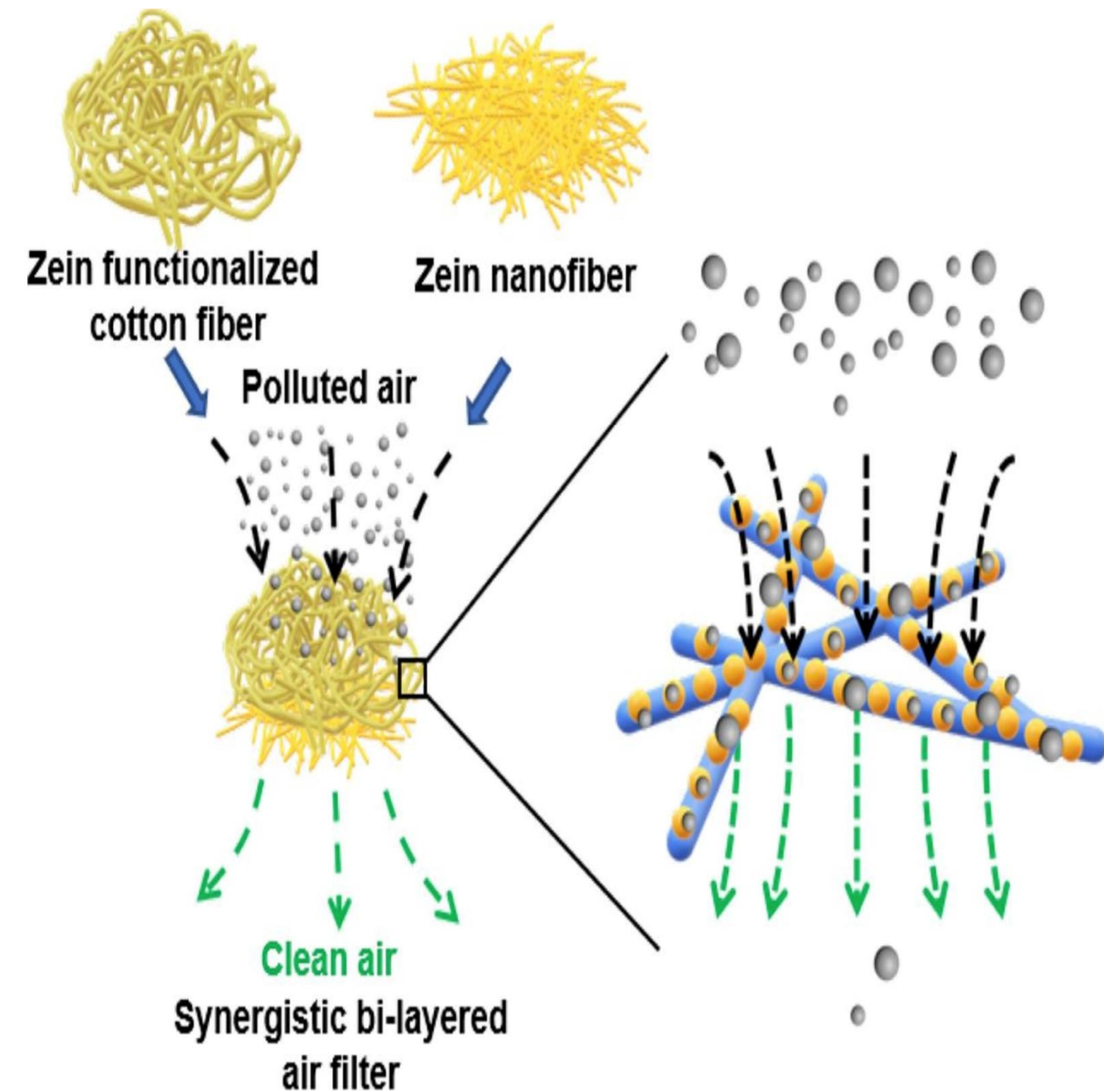
Chemical Modification

- Surface coating (dip-coating, spin-coating, spray-coating)
- Polymer grafting
- Plasma (altering the hydrophobic or hydrophilic nature of polymer surfaces by exposure to plasma)



Fiber Chemical modification

- Protein-functionalized on cotton-fiber air filter
- homogeneously distributed protein particles and an optimized surface area for interactions between protein and pollutants
- bi-layered air filter combining the zein-functionalized cotton fibers with a thin layer of protein nanofibers to enhance the filtration efficiency

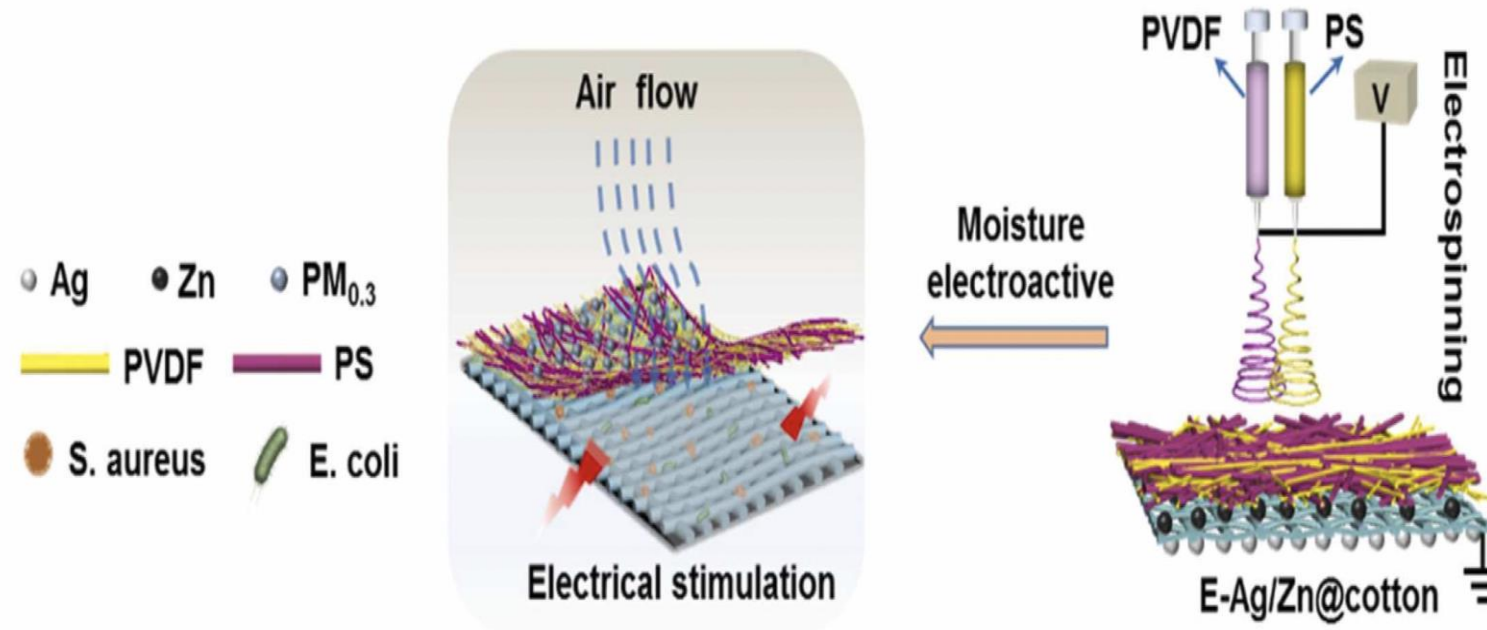
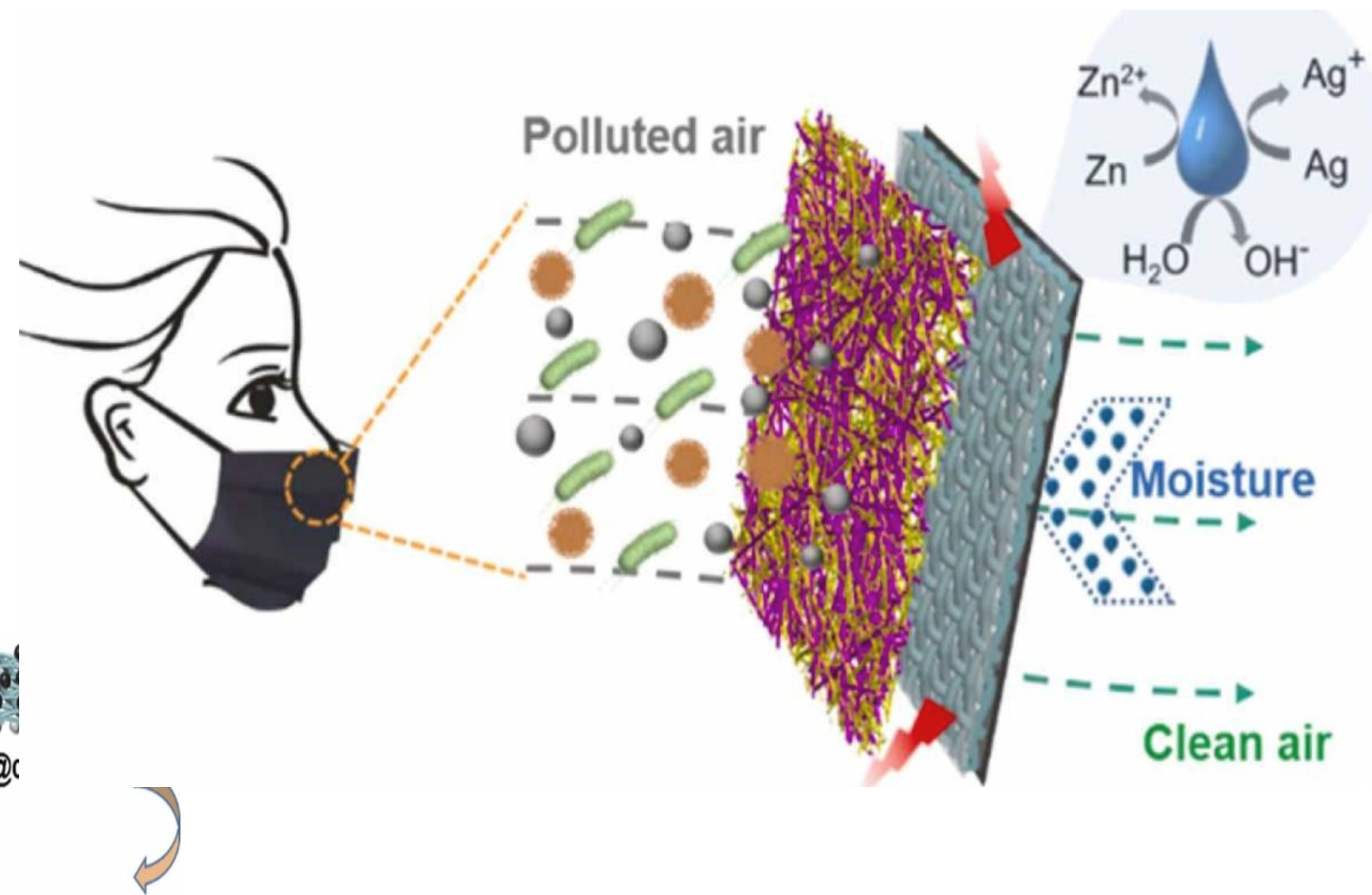
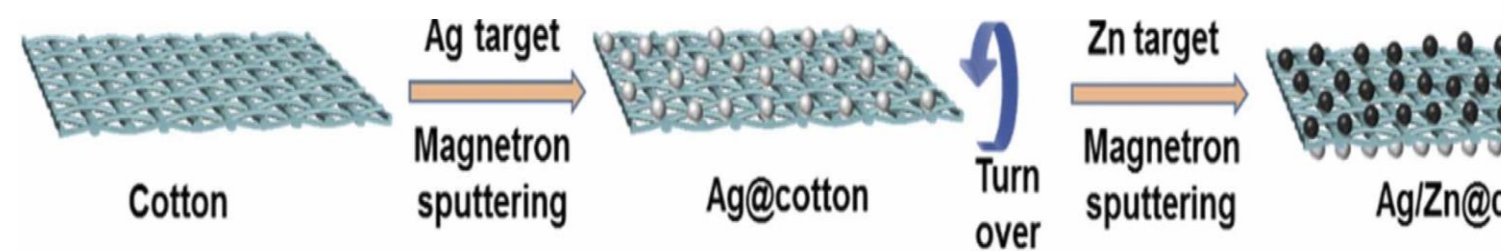


Protein-functionalized cotton-fiber air filter via an evaporation-controlled strategy,

Liu et al., 2019

Cotton fiber surface modification studies

- A bilayer structured composite filter
- cotton woven modified by Ag/Zn coatings and electrospun poly(vinylidene fluoride)/polystyrene (PVDF/PS) nanofibers
- Endowed antimicrobial ability
- High filtration efficiency towards $PM_{0.3}$ (99.1%, 79.2 Pa)



Future work

- Utilizing other sources of **natural fibers** such as Hemp, Jute for fabricating air filters
- **Multi-layers filters** making of different types of fibers or from a single fiber
- Woven or nonwoven filter media
- **Electrostatic modification** of fibers
- Using natural biomass fibers for **water treatment** applications in order to **purification, filtration or separation** water from pollutants (For example oil/water separation)



Thank you!

