GHOST PELLICLE
particle contamination control
## FOR EUV LITHOGRAPHY

EDGEX CO., Ltd

2022

01 **EDGE X**

EDGEX COMPANY PROFILE

EdgeX is a spin-off startup company set out to bring new products and service technologies to the market.

18 products and innovations registered at the Korean Intellectual Property Office.
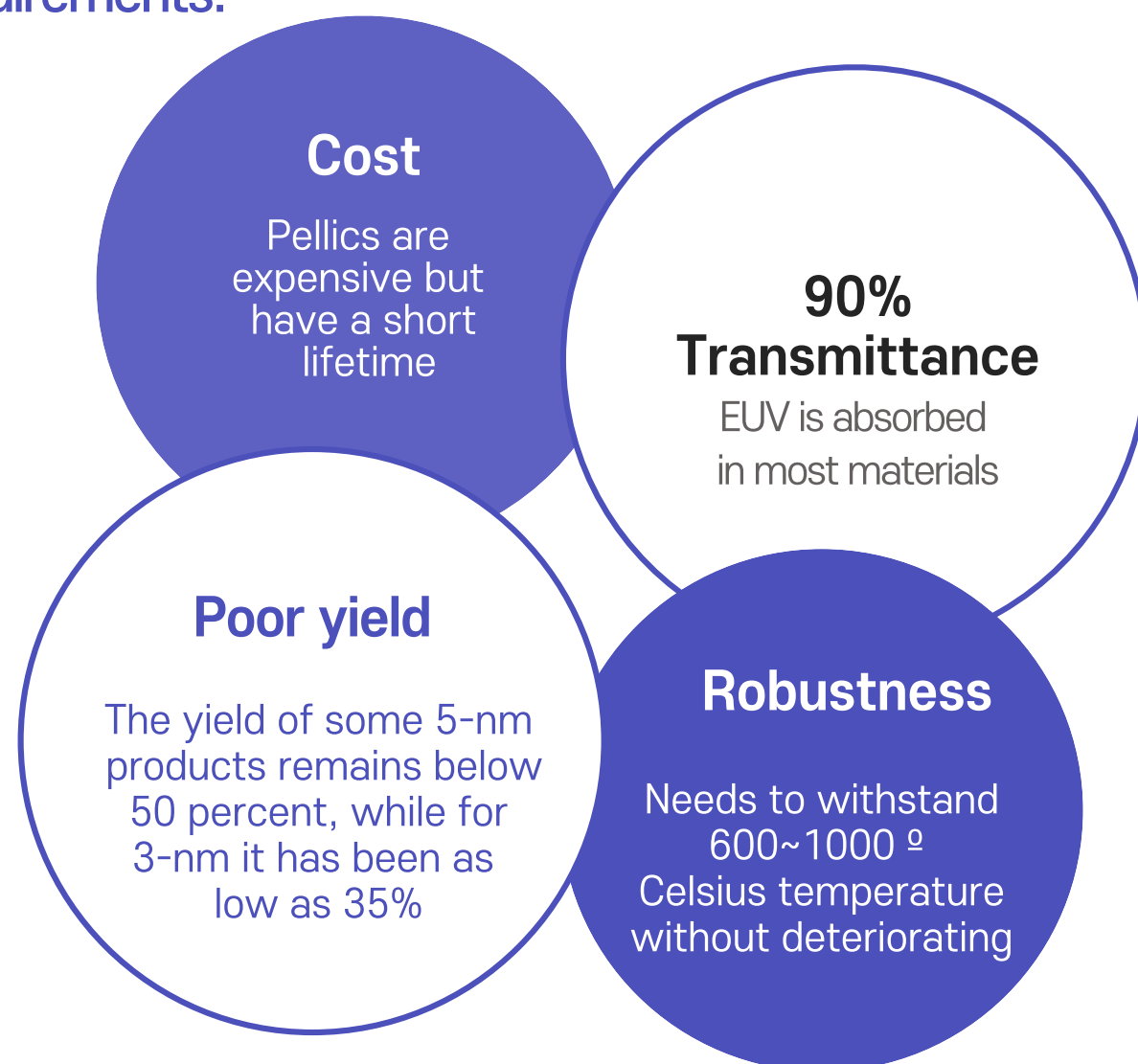
HEAD COMPANY

Korea Nuclear Engineering Management Corporation (KONEC) focuses on the management of nuclear and radioactive waste, and provides engineering services.
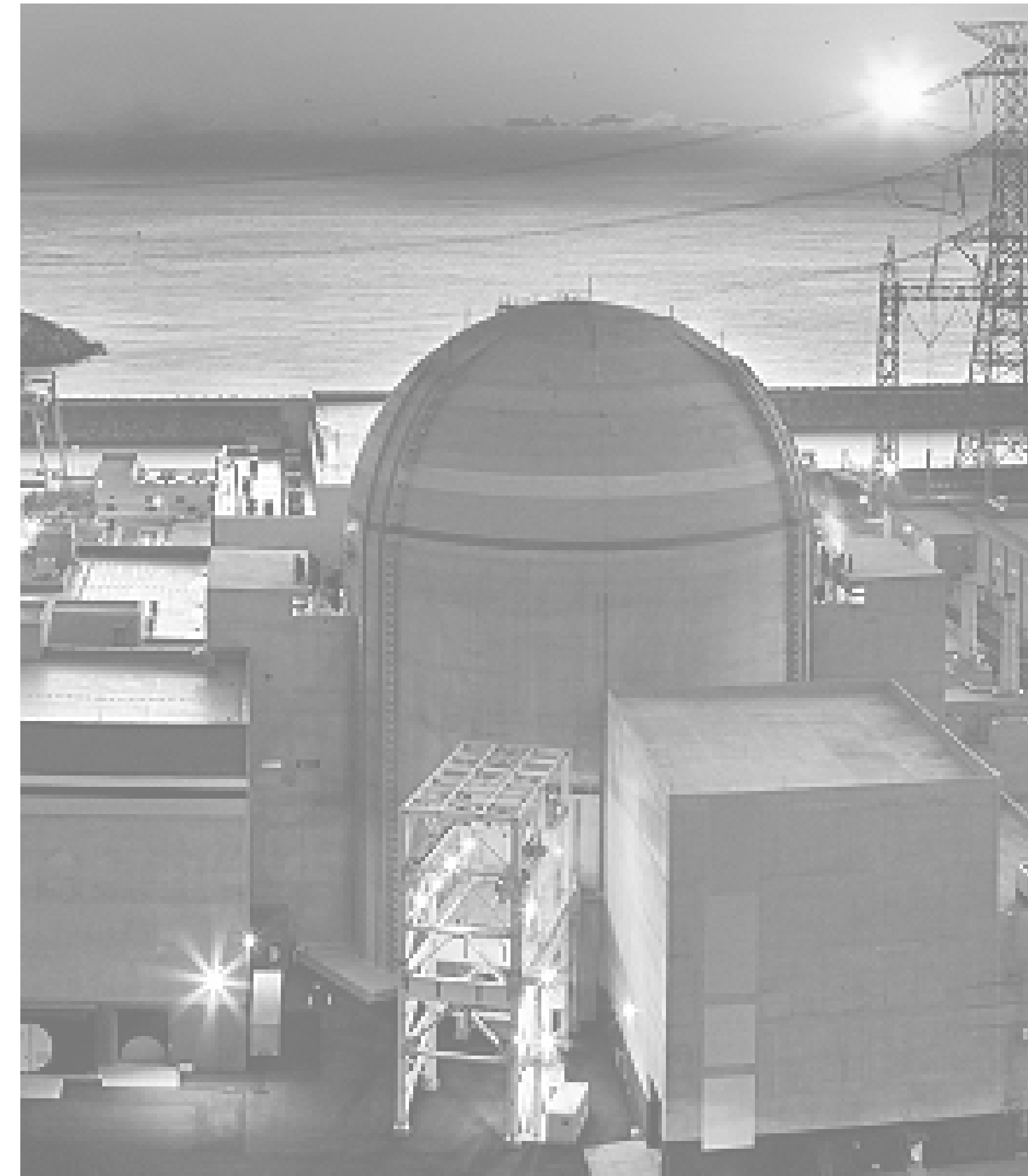
02 DIFFICULTIES IN DEVELOPING EUV PELLICLES

PELLICLES AND
EXISTING PROBLEMS

Pellicle requirements:

Cost

Pellics are expensive but have a short lifetime

90% Transmittance

EUV is absorbed in most materials

Poor yield

The yield of some 5-nm products remains below 50 percent, while for 3-nm it has been as low as 35%

Robustness

Needs to withstand 600~1000 º Celsius temperature without deteriorating
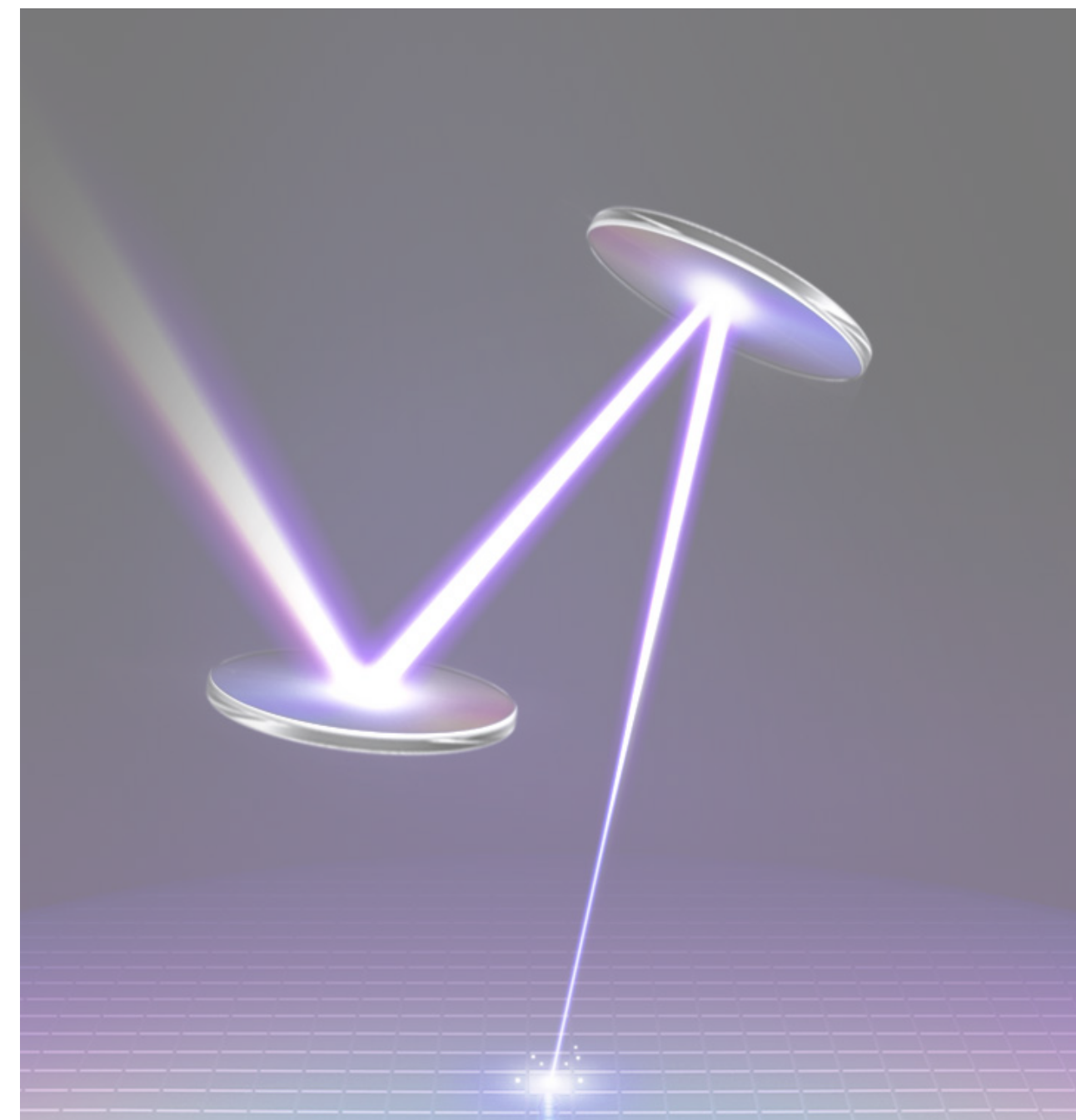
- The device output and yield is affected adversely by factors such as molecular or particulate contamination on critical imaging surfaces.

- If a particle lands on a mask, the scanner could print repeating defects on the wafer, which negatively impacts yield.

- Pellicles are also expensive, the the average price for an EUV mask is approximately $300,000, according to analysts.

- However, the challenge is to find the right pellicle material that can dissipate the heat and maintain the desired transmission rates.

- TSMC and Samsung are using EUV lithography tools without pellicles on multi-die photomasks for smaller chips, but such methods are risky as any particle adder can become a yield-killing defect.
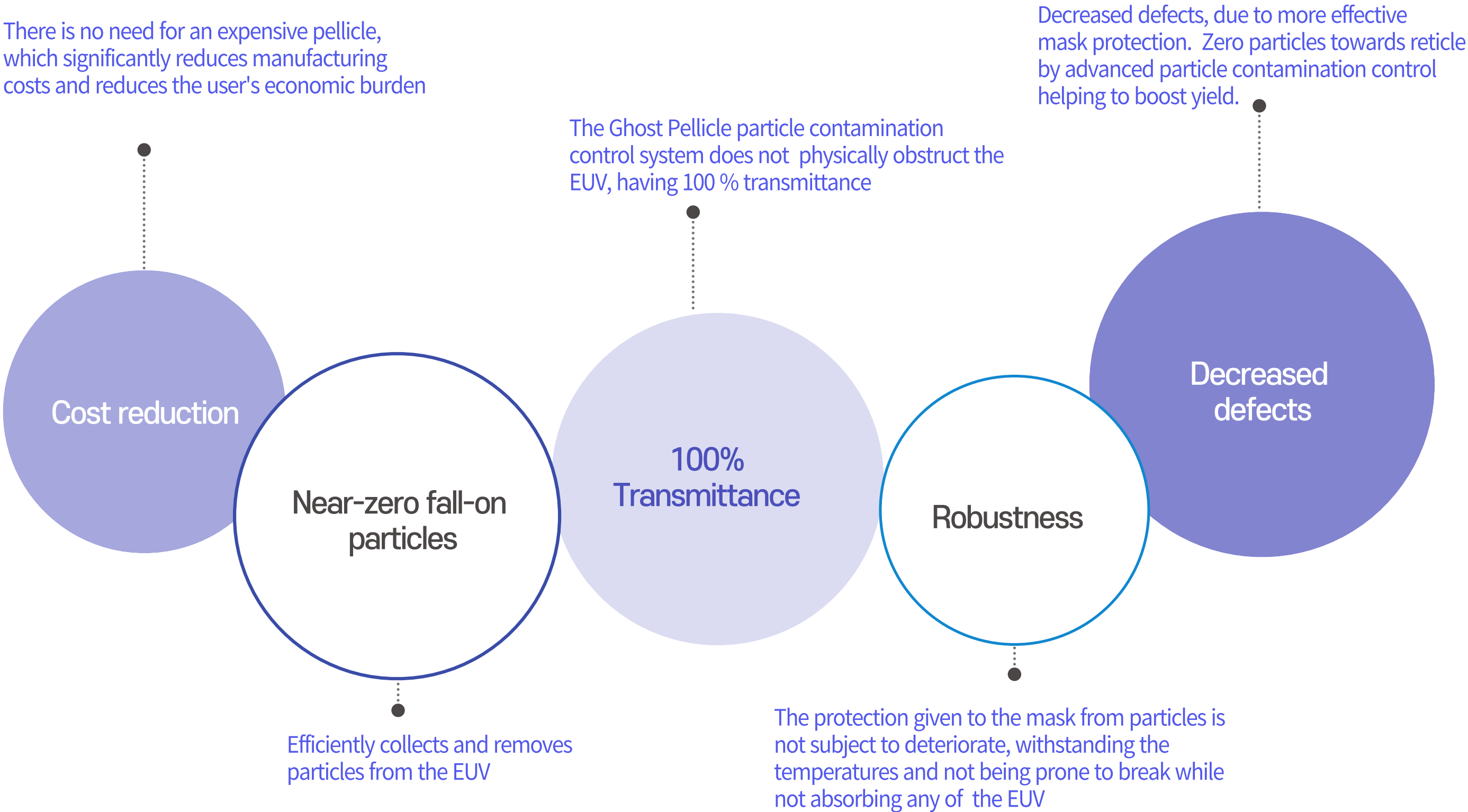
03 EDGE NEW TECHNOLOGY

GHOST PELLICLE
PARTICLE CONTAMINATION CONTROL SYSTEM

- **An advanced particle contamination control system for EUV lithography.**
  Near-zero particle contamination without a physical pellicle or obstruction to the EUV.

- **Minimizes the molecular and particle contamination in the EUV system.**
  Works towards zero fall-on particles.

- **An invisible protective field for the mask**
  Utilizes electrostatic plates and an electron-gun to protect particles from landing on the mask.

BENEFITS

There is no need for an expensive pellicle, which significantly reduces manufacturing costs and reduces the user's economic burden

Decreased defects, due to more effective mask protection. Zero particles towards reticle by advanced particle contamination control helping to boost yield.

The Ghost Pellicle particle contamination control system does not physically obstruct the EUV, having 100 % transmittance

Cost reduction

Near-zero fall-on particles

100% Transmittance

Robustness

Decreased defects

Efficiently collects and removes particles from the EUV

The protection given to the mask from particles is not subject to deteriorate, withstanding the temperatures and not being prone to break while not absorbing any of the EUV

04 PARTICLE CONTAMINATION CONTROL

Purpose: To make sure all the particles get charged and collected from the key parts of the EUV

ELECTRON-GUN

ELECTOSTATIC-PANEL
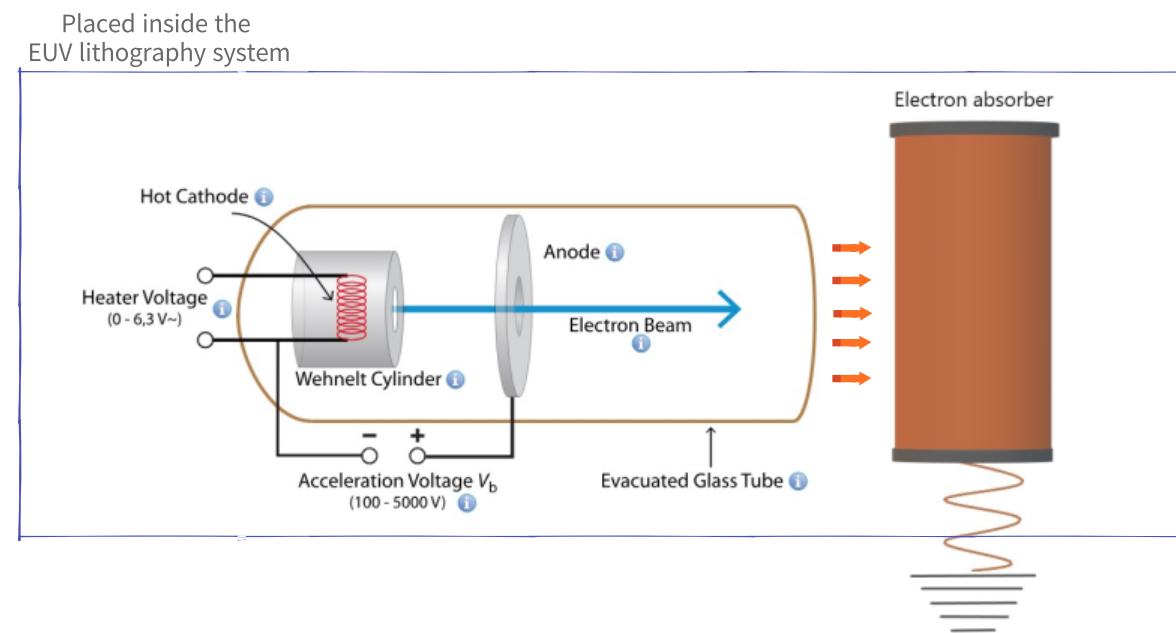
An electron gun can be used to ionize particles by adding electrons to, or removing electrons from an atom. The particles become charged as they attract the charged ions from the electron-gun by electrostatic attraction.
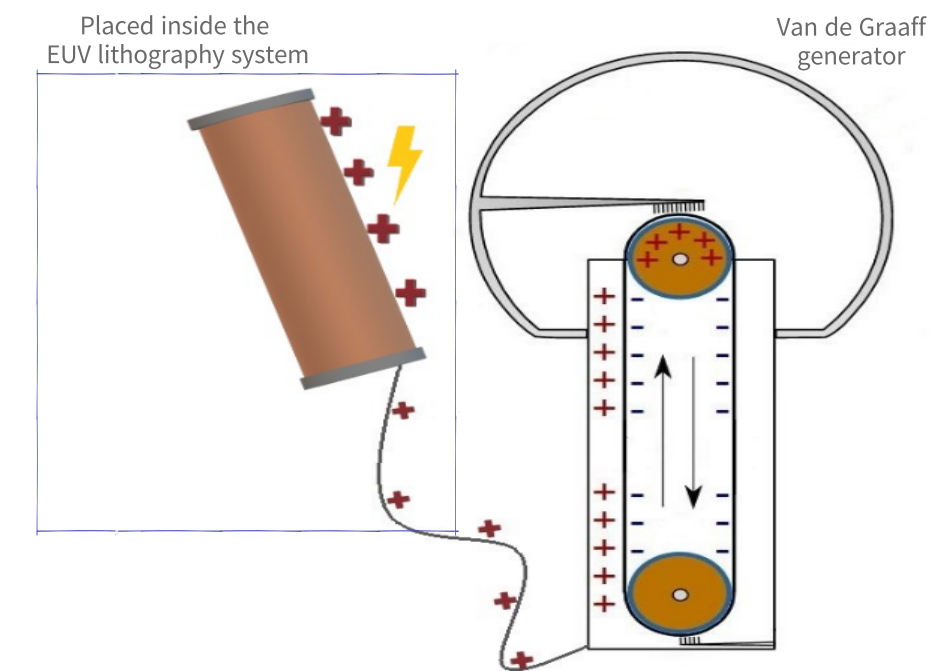
The charged particles, in turn, are then attracted to the nearby the electrostatic plates, also positioned inside the EUV lithography system.

ELECTROSTATIC PANEL

The electrostatic force is an attractive and repulsive force between particles that is caused by their electric charges.

Effective for removal of contaminant particles on surfaces and for manipulation and transport of micro and nanoscale particles.

Commonly used to remove fine particles, it collects the charged particles through electrostatic attraction.

A Van de Graaff generator, an electrostatic generator is used to generate the electrostatic change in the panel. The Van de Graaff generator can be placed outside the EUV and connected through electric cables to the electrostatic panels.

BENEFITS:

➡   Can be installed inside the projection system or around the projection path.

➡   As the device itself is charged with a larger amount of static electricity, it attracts the particles charged with negative electricity.

➡   Conical cylinder-shaped electrostatic preciprator enables the increased efficiency of the particle removal.
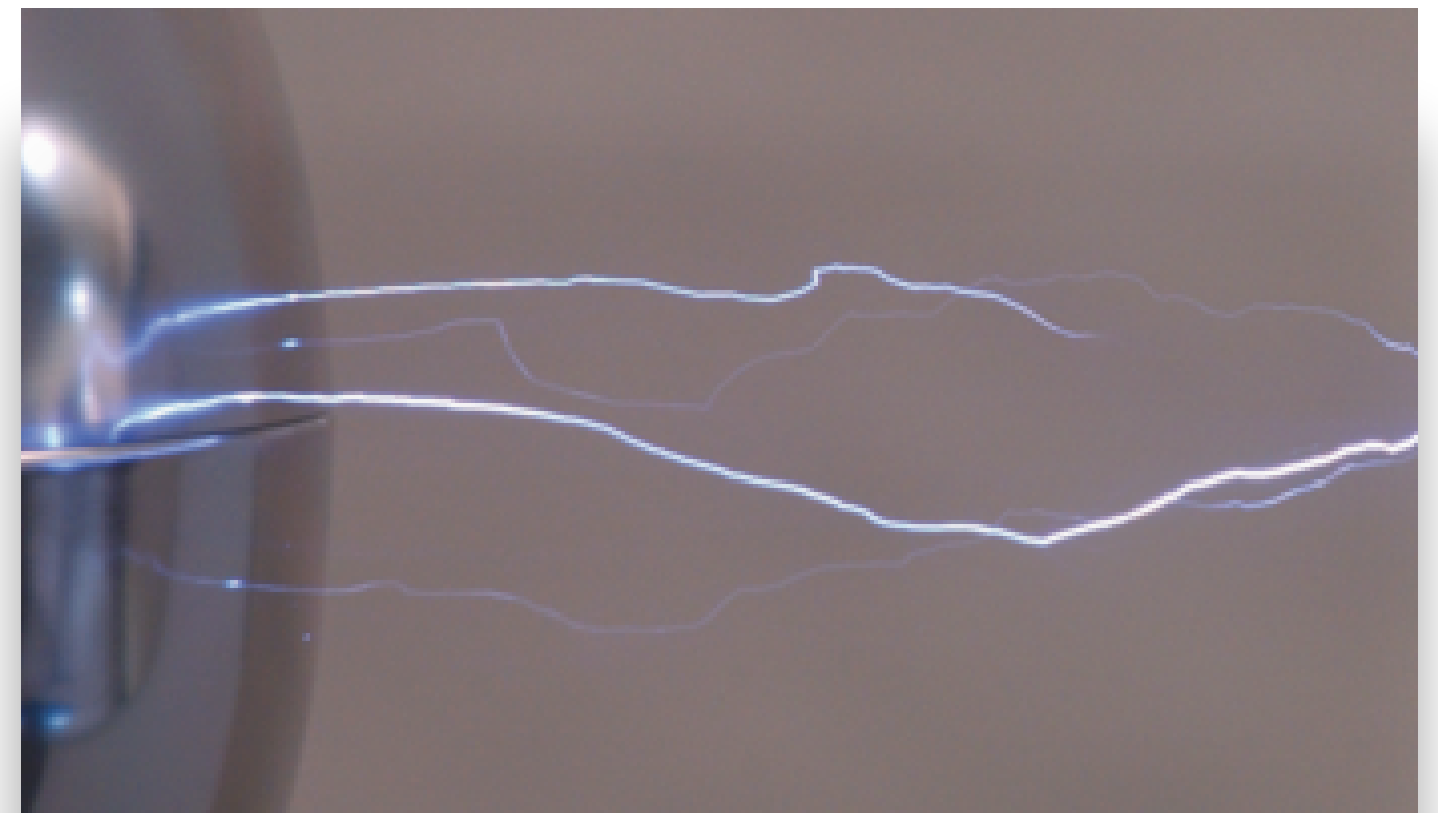
APPLICATION OF THE GHOST PELLICLE

Electrostatic panels a)

Studies show that electrostatic mechanisms are effective for particle removal in even in the high vacuum region (higher than $10-2$ Pa) if the particles are charged.

Electron-gun b)

The electron-gun ionizes the particles and molecules inside the EUV system, so that they will be collected by the electrostatic panel.

MASK

a)

b)
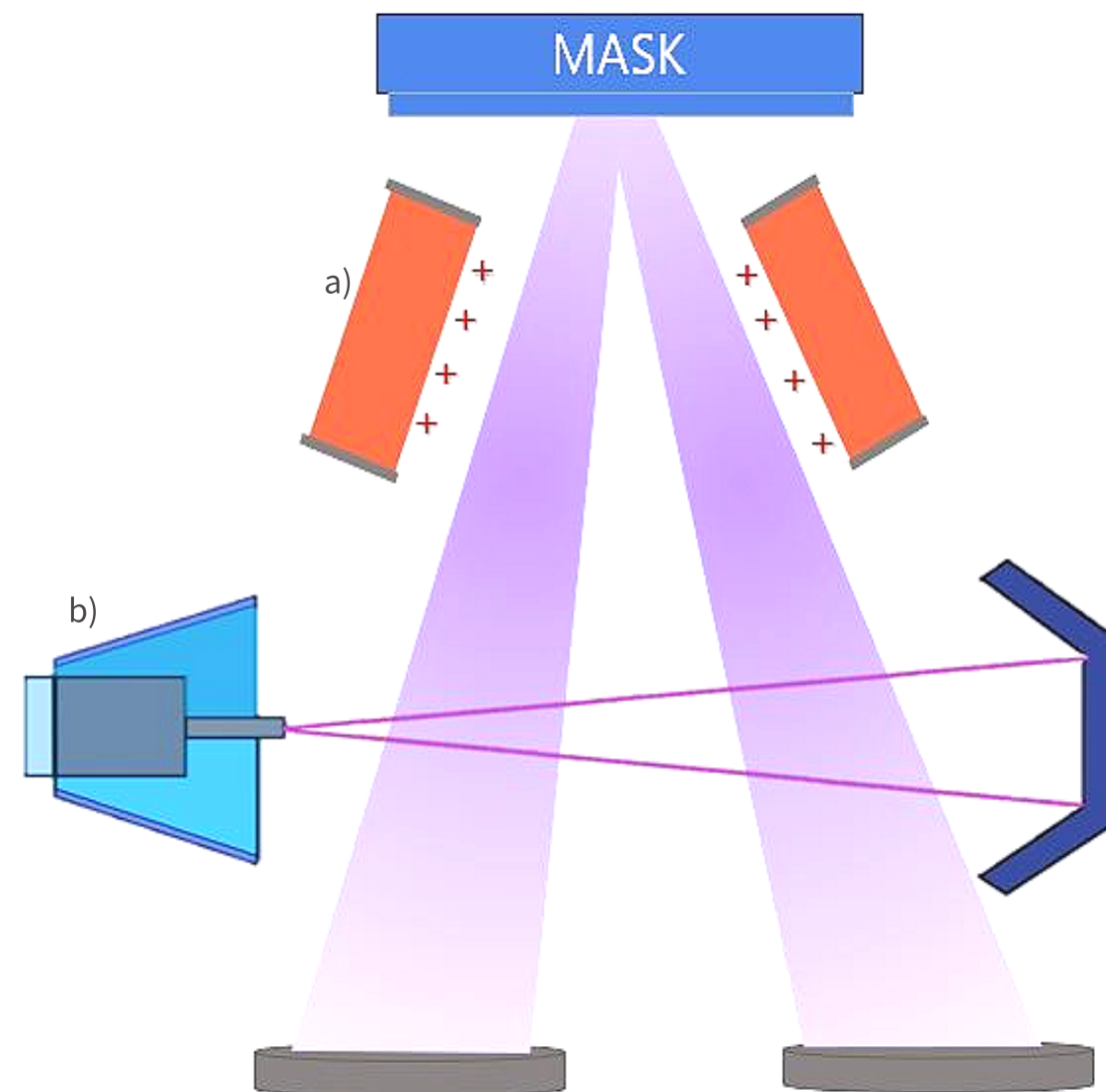
The Ghost Pellicle particle contamination control system consists of the electron-gun that charges the particles and the electrostatic panels that collect them.

The Ghost Pellicle works as a protective field and protects the mask and the substrate (wafer) from particles and other types of contamination sources inside the EUV lithographic system.

SYSTEM MECHANISM PROCESS

B: EUV radiation beam

SO: Radiation source

MA: Mask, patterning device

W: Substrate

LA: Lithography device

IL: Lighting system

PS: Particle contamination control system

21:     Electrostatic panel

22:     Electron-gun

22b: Grounded conductor
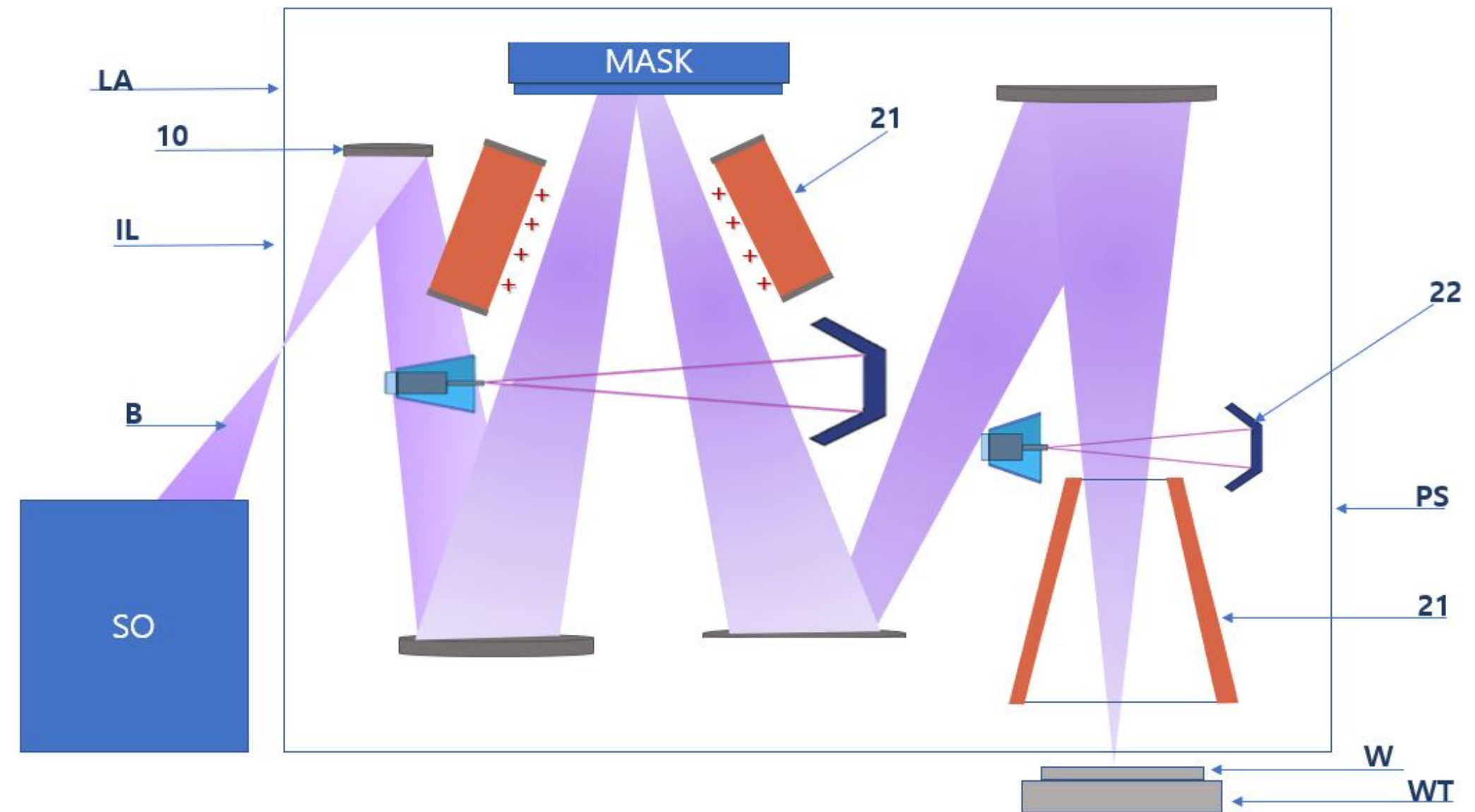
WHAT THE GHOST PELLICLE OFFERS:

01

Reduces defects considerably by increasing particle contamination control through the Ghost Pellicle technology offering near-to zero fall-on particles.

02

Saves cost considerably from pellicle costs as well as from mask replacement and yield loss. As any particle can become a yield-killing defect, there is a need for near-zero particle contamination control.

03

Offers 100% transmittance, as the pellicle works through electrostatic mechanisms instead of placing a physical barrier for particles and the mask.

04

With EUV moving to 3nm, 2nm production following that, it ultimately aiming for the 1nm nodes production, the need to control for particles and molecules increased, however the invisible pellicle technology makes this possible.

Thank you

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