Filter Technology Developments to Address Defectivity in Leading-edge Resists

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KEY TAKEAWAYS

- Entegris has innovative filter technology to control membrane properties to reduce defects in advanced photoresists
- New membranes have been designed to enhance retention performance without sacrificing flow rate
- Oktolex™ technology enables tailoring of surface properties for selective defect removal
- Reducing metals in photoresists can suppress polymer agglomeration

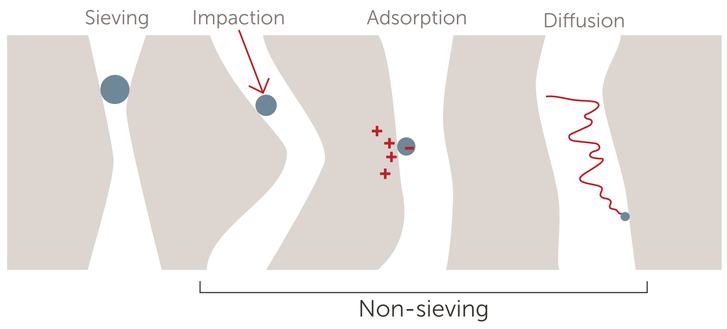
ABSTRACT

Conventional filters such as Nylon and UPE (ultra-high molecular weight polyethylene) have been used in manufacture of photochemicals and new filtration technologies must be developed to innovate along with chemical suppliers.

Entegris has recently developed several innovative membranes: a next generation UPE and Oktolex. The next generation UPE membrane overcomes the trade-off between flow rate and pore size, while also being compatible with a range of chemistries. The Oktolex membrane selectively removes defects based on tailored membrane modification technology, further addressing defect sources that come from newly formulated chemistries.

INTRODUCTION

There are many different membranes that make up the robust portfolio that addresses a wide-range of photochemical filtration needs. These membranes are chosen to address different retention mechanisms for various contaminants.



Size Exclusion

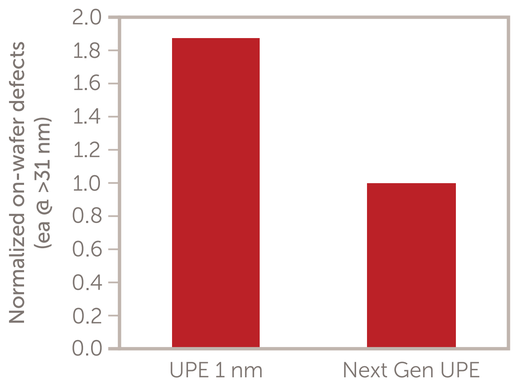
To address size exclusion of the smallest particles, next generation UPE membranes have been developed to create more opportunities for physical capture of contaminants. Pore size reduction alone has reached a limit whereby flow rates would reduce to unusable levels without additional membrane innovations. Modern UPE membranes create both smaller and more pathways for contaminant capture.

Adsorption

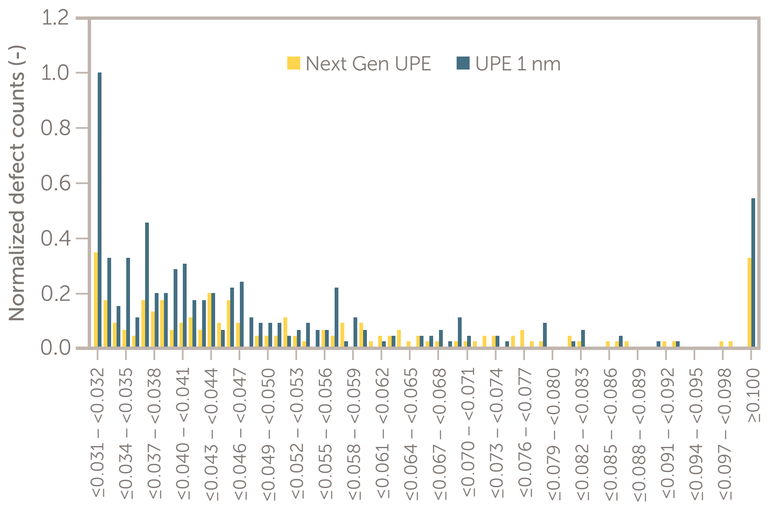
Adsorption mechanisms can best be addressed by base membrane selection and membrane modification. Historically, nylon was chosen, as it naturally has an assortment of intermolecular forces on its surface with which contaminants can interact. However, nylon can also negatively impact a photoresist, altering exposure conditions. New base membranes, like Oktolex, can leverage a wide variety of surface modification techniques to create strong intermolecularly forces. Through tailoring, a membrane can be designed to have a higher affinity to metals, which would reduce polymer aggregation.

EXPERIMENT AND RESULTS: SIZE EXCLUSION

- Filters:
  - 1 nm UPE
  - Next Generation UPE
- Defect analysis: KLA-Tencor Surfscan® SP5



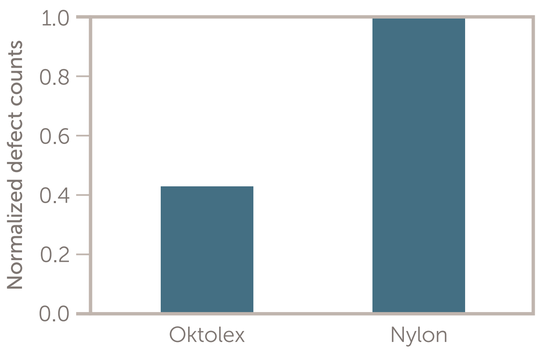
Next Gen UPE exhibits a nearly 2× reduction in total defectivity when compared to a 1 nm UPE.

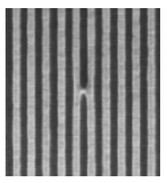


A standard 1 nm UPE filter allows the passage of more, smaller defects than the newly developed UPE membrane. This is likely because of the structure of the next gen UPE membrane, where there are more, smaller passages to capture the smallest particles.

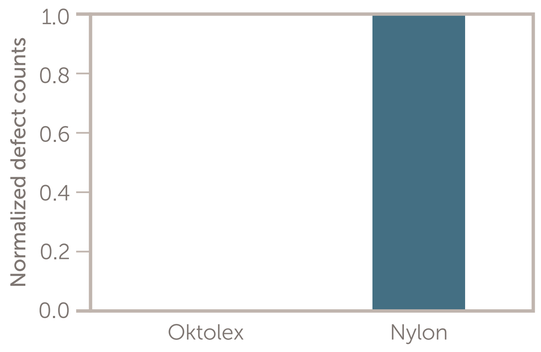
EXPERIMENT AND RESULTS: ADSORPTION

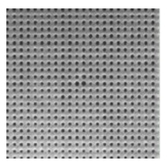
- Filters:
  - Nylon
  - Oktolex
- Patterned defectivity inspection and SEM review
- Metals concentration testing after filtration



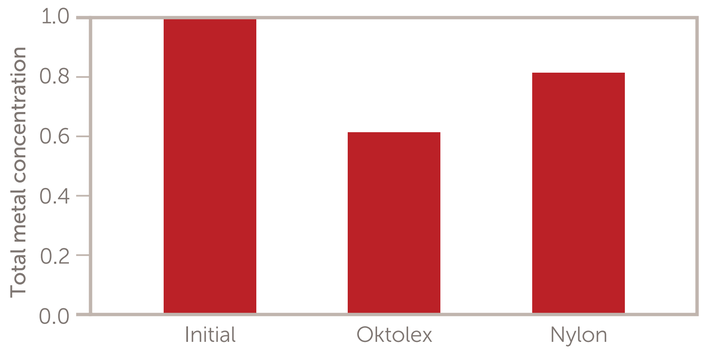


The Oktolex filter had better bridge defect removal performance when compared to an advanced nylon filter.





The Oktolex filter did not exhibit any hold deformation defects.



The Oktolex filter was more effective at metal removal than a nylon membrane.

CONCLUSIONS

- Filter manufacturers continue to innovate using standard and new materials to be able to address more stringent defect requirements.
- Understanding both the chemistry and retention mechanisms is important to make good decisions about photochemical filtration.