

# A Kidney-on-a-Chip for Investigating Glomerular Filtration Barrier Functions

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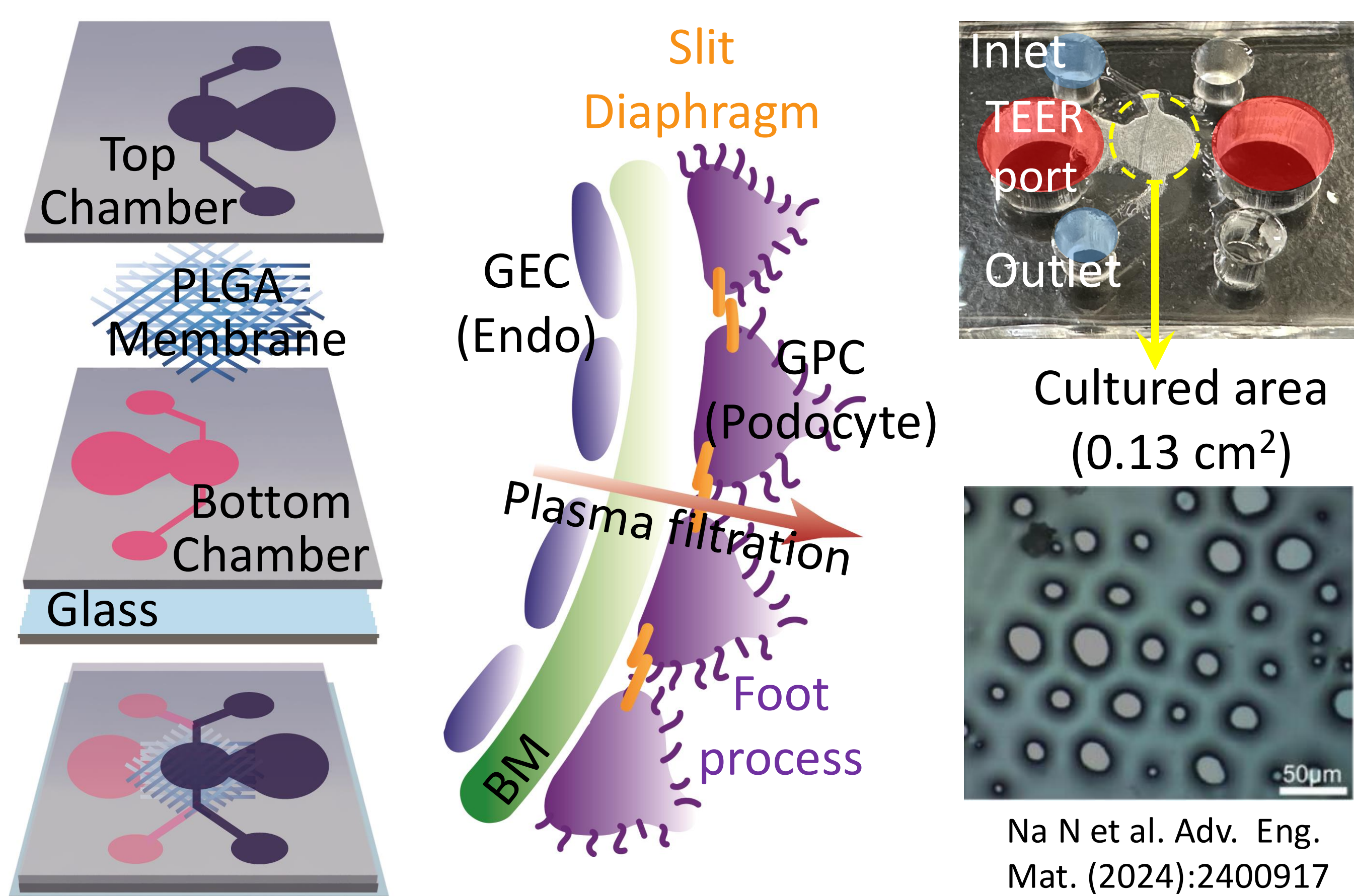
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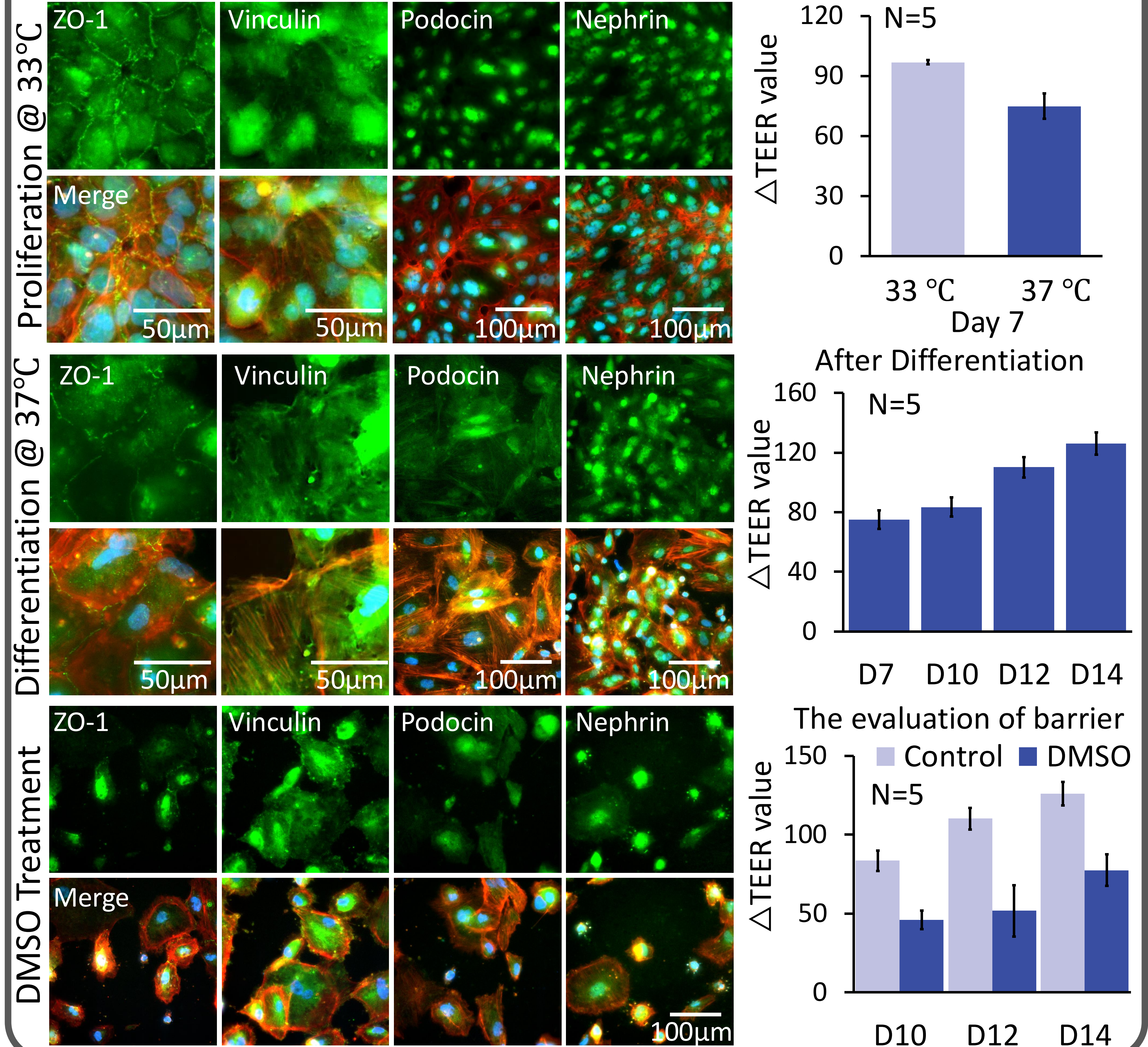
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- The kidney glomerular filtration barrier selectively filters blood through three layers: endothelial cells, basement membrane, and podocytes.
- Traditional polycarbonate (PC) membrane chips limit natural cell-to-cell interactions, making barrier formation studies difficult.
- We developed a glomerulus-on-chip using electrospun PLGA membranes to better mimic physiological cell interactions and study filtration.

## Kidney Glomerulus Chip Fabrication



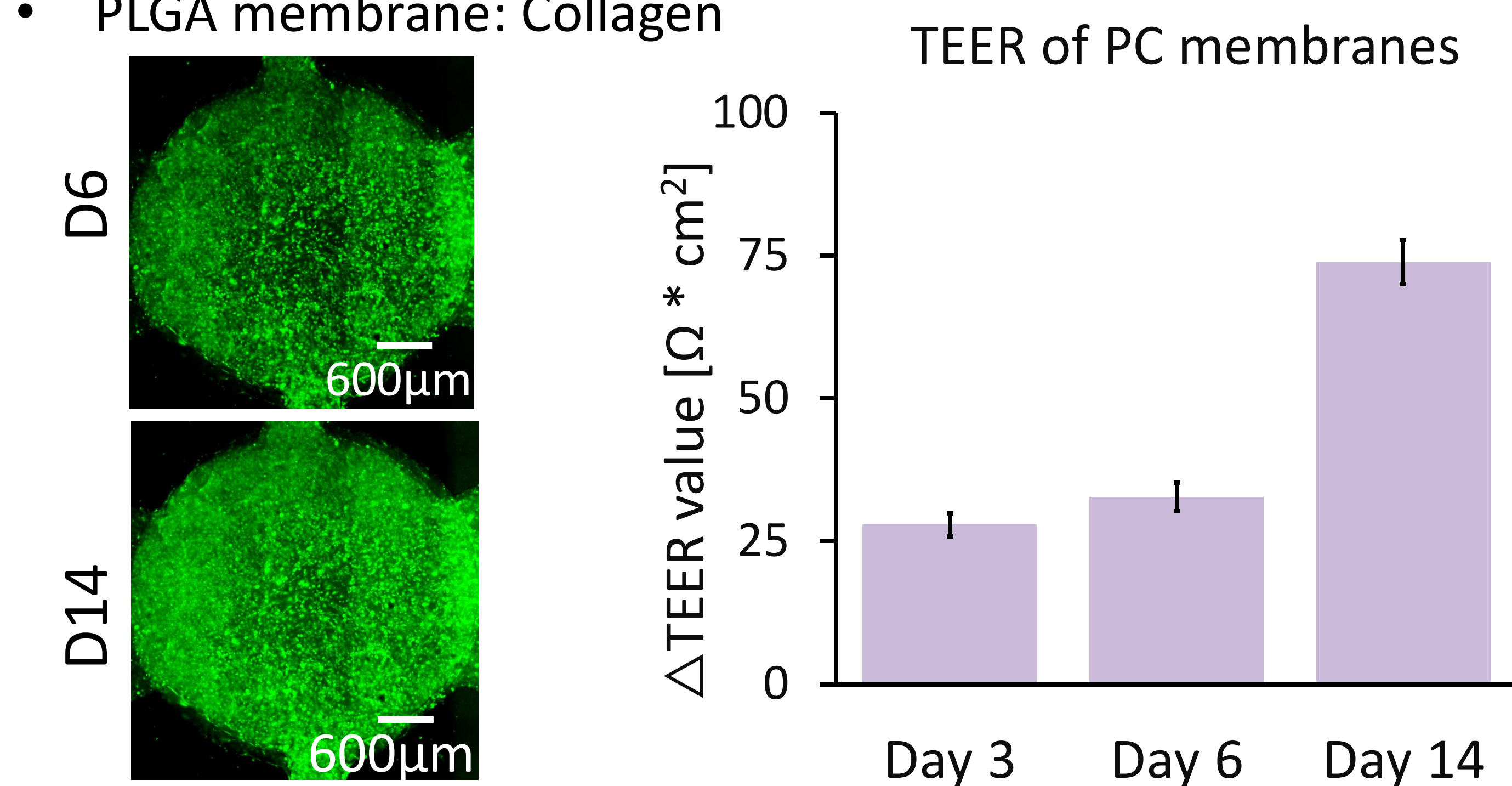
## On-chip podocyte layer formation



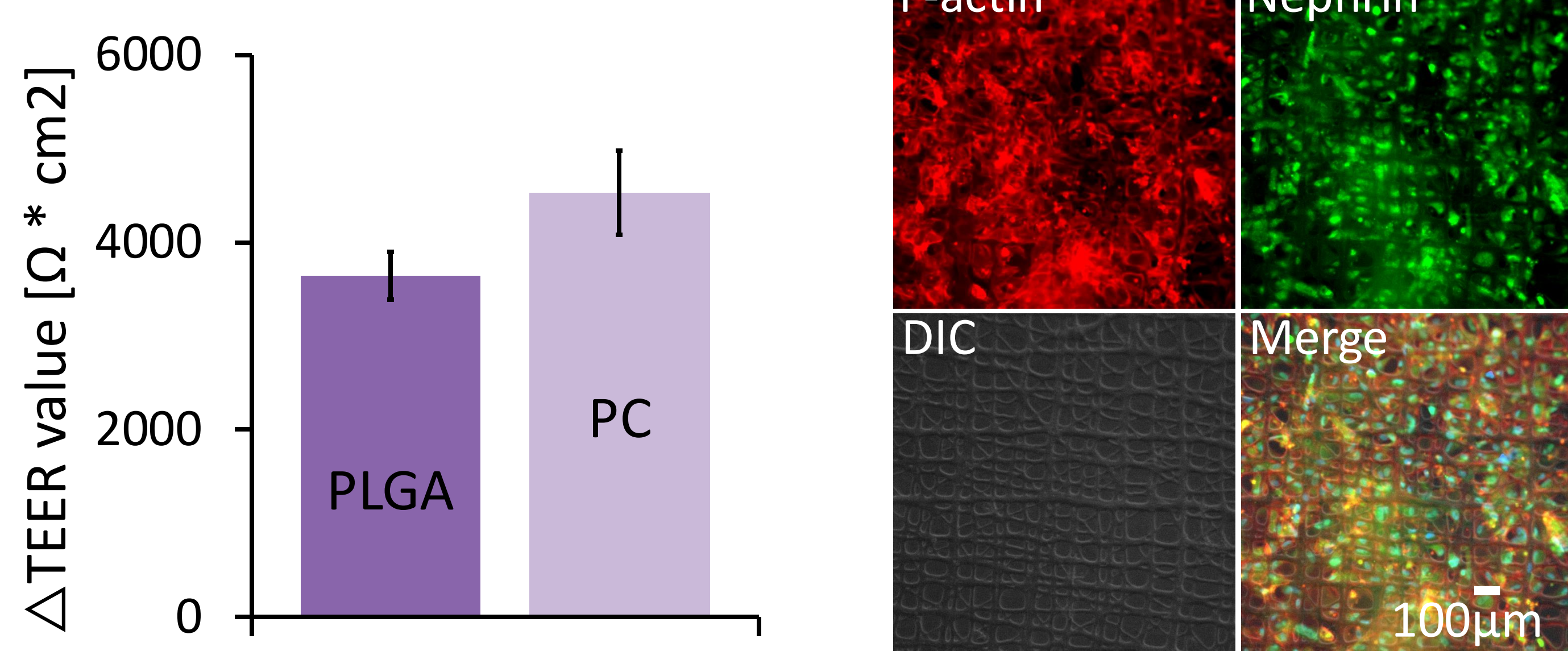
## Chip Characterization

### Coating solution

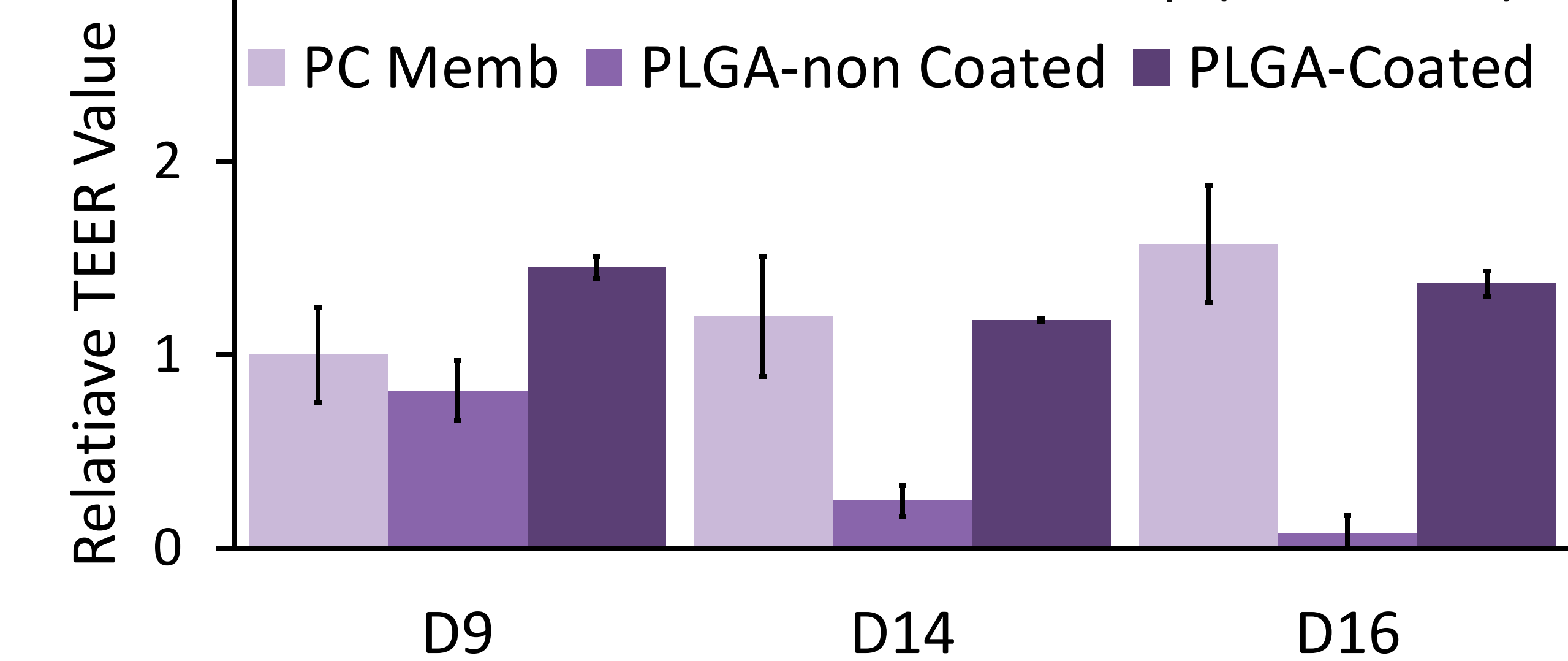
- PC membrane: Collagen assisted by polydopamine
- PLGA membrane: Collagen



### Membranes on a chip (w/o cells)

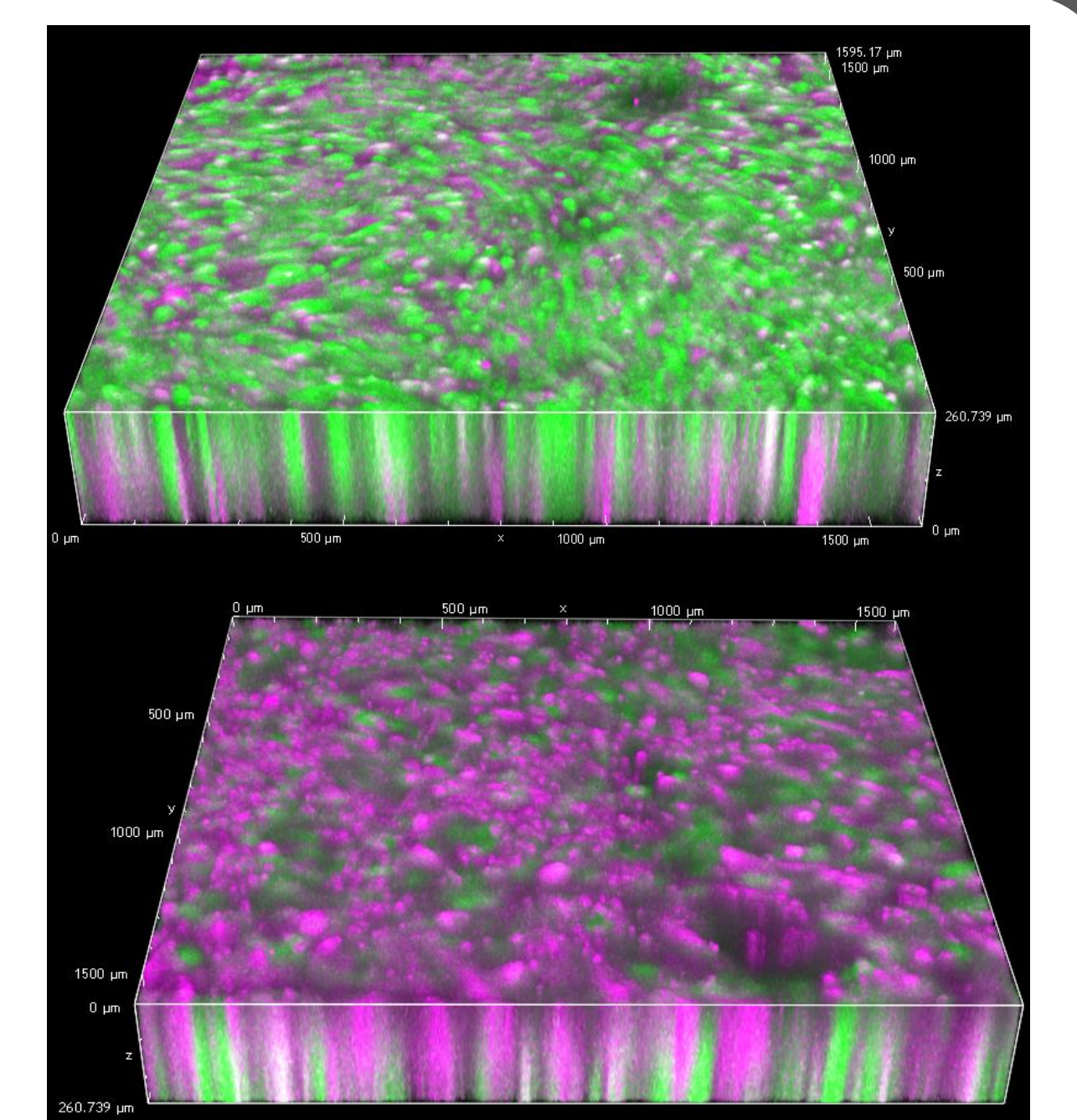
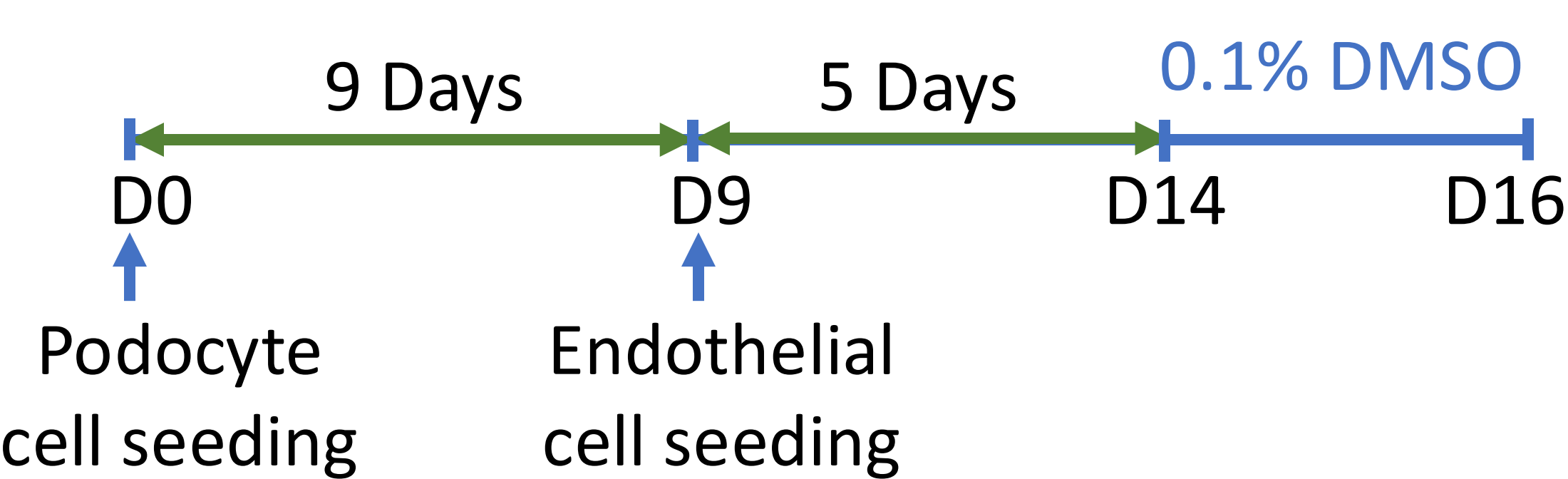


### Different membranes on a chip (co-culture)

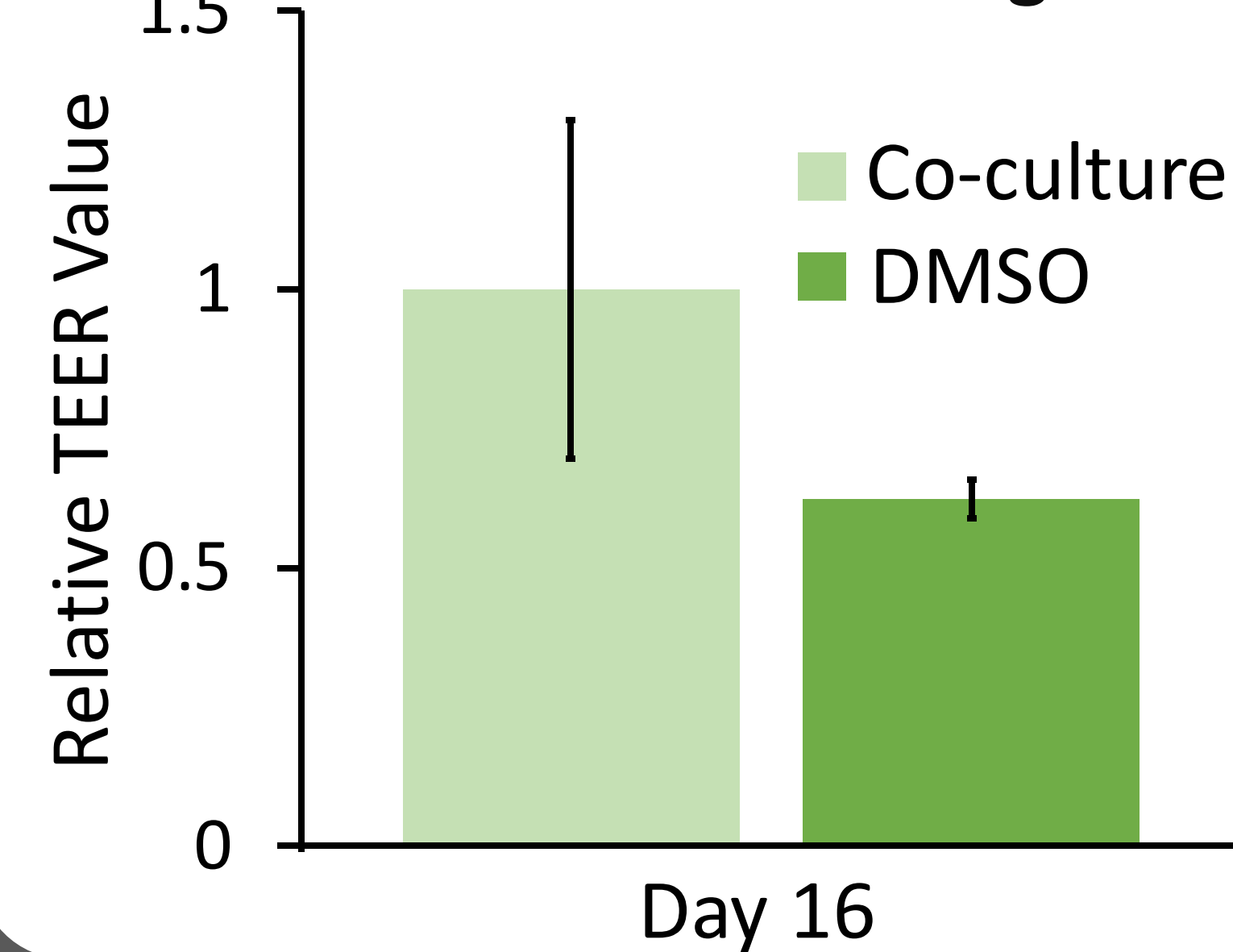


## On Chip Glomerulus Barrier Formation

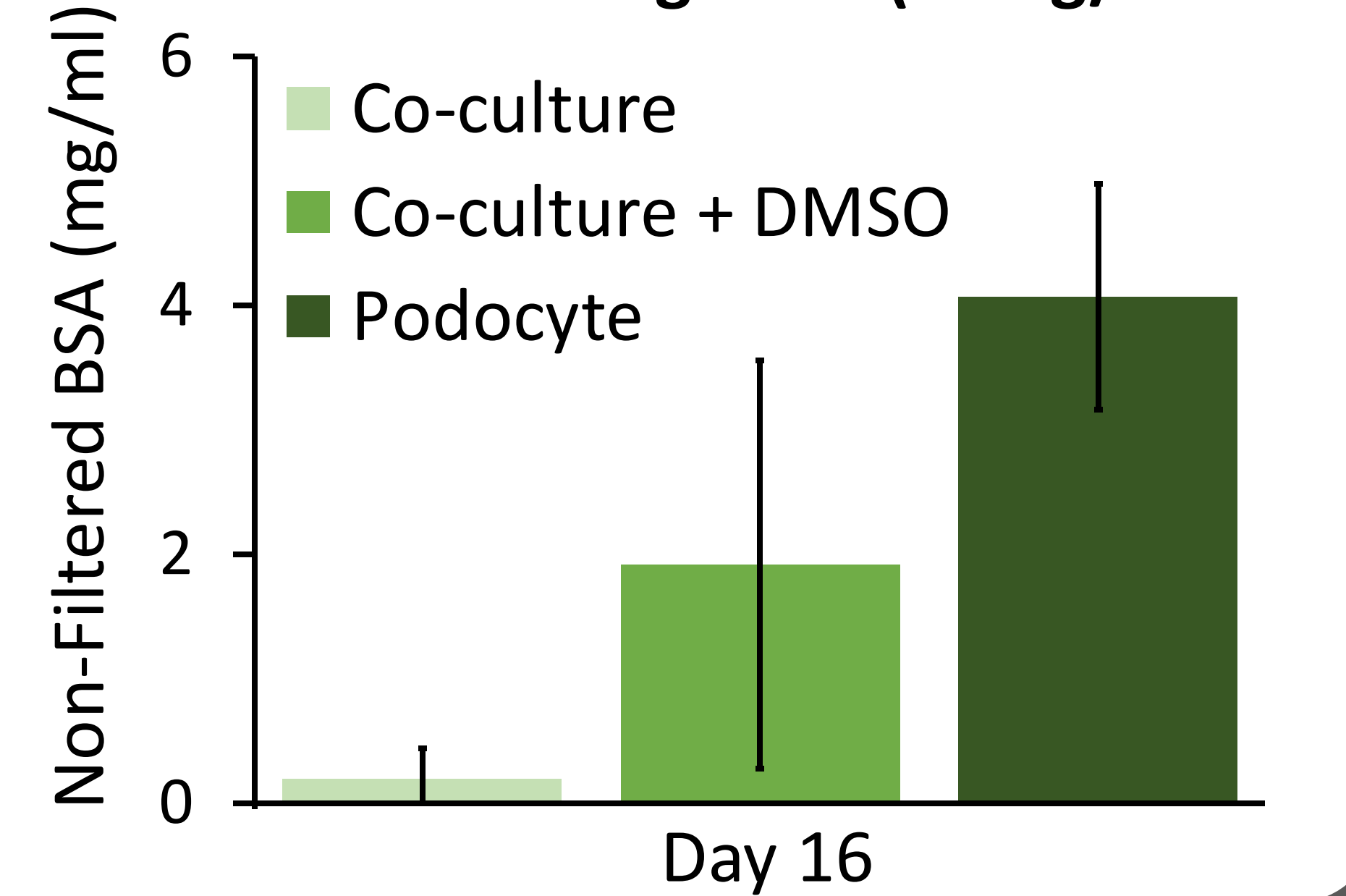
- Immortalized Kidney glomerular Podocyte
- Primary Kidney glomerular Endothelial cells



### Junction breakage



### Albumin Leakage test (10mg/ml BSA)



- PLGA membranes with simple surface modification (collagen only) enhanced GEC-GPC interactions.
- Differentiated podocytes showed proper slit diaphragm formation with nephrin/podocin expression and enhanced foot processes, demonstrated by increased vinculin, cytoskeleton strength, and TEER values.
- Co-culture of GECs and podocytes created a stronger barrier against albumin leakage than podocyte-only cultures.