Breakout Session 3: Membranes & Substrates and Associated Functional Materials and Technologies for Crosscutting Applications

Focus question #1C: VISION AND GOALS

- Low cost at production scale
- Large scale
- Low fouling
- Uniformity with few defects
- Multifunctionality
- High throughput
- Stability in harsh environments
- Good control over material properties (e.g. hydrophilicity)

Focus question # 2C: CHALLENGES

- R2R Materials Challenges:
  - Porosity, defects, nanostructure
  - Materials compatibility issues
  - Temperature, mechanical, and humidity stability
- Metrology, Sensors, and Process Control Challenges
  - Lack of in situ / inline metrology tools and real-time feedback
- Predictive Modeling and Computational Tools
  - Lack of fundamental models, especially for nanoscale materials
- Technology Transfer and Scale-Up
  - Capitol costs
  - Lack of shared equipment / resources

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Focus Question #3A, 3B, and 3C: R&D NEEDS

- **Materials development:** increased membrane selectivity; materials with graded properties; control over defects and surface roughness; multifunctional materials, including multi-material composites
- **Metrology and process control:** real-time / in-line process control; characterization of nanostructure over large areas
- **Modeling and computational tools:** models to correlate process parameters with functionality at high production rates
- **Scale-up:** module development (incorporation of R2R component into a successful product); adaptation of new materials into existing infrastructure

Key R&D Focus Areas:

- Materials and substrates: taking high temperature functional materials into R2R
- Metrology and process control: develop real-time feedback loop for process control
- Membrane design: preserve high quality while transitioning to production scale
- Scale-up and tech transfer: open access to information and drive faster iteration between R&D and commercialization