Advancing Post-Combustion CO_2 Capture through Increased Mass Transfer and Lower Degradation

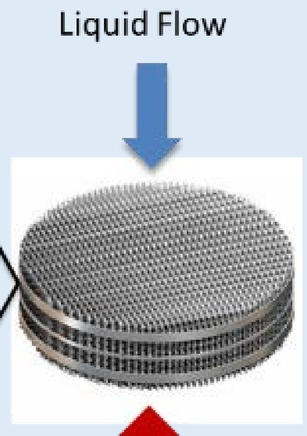
Center for Applied Energy Research

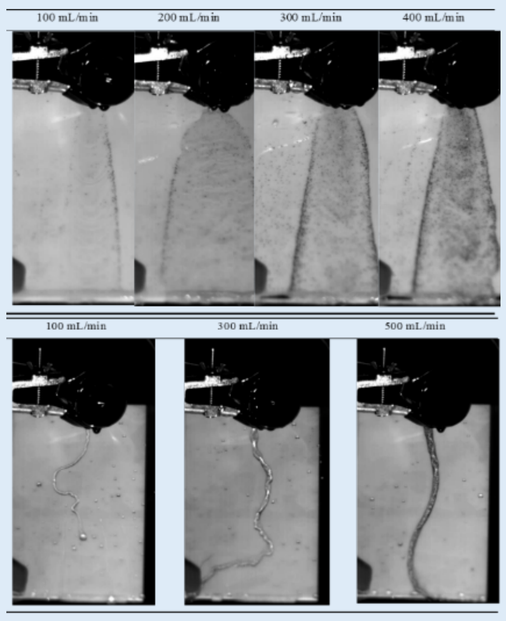
Increased turbulence and mass transfer with dynamic (hydrophilic/hydrophobic) packing material

Increase CO_2 mass transfer into amine solvents through the development of dynamic polarity packing material that is designed to increase turbulent liquid flow and controlled gas-liquid bubble formation

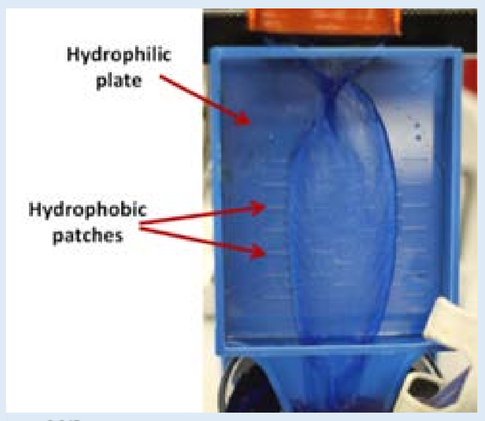
Partnership with Lawrence Livermore National Laboratory (LLNL)

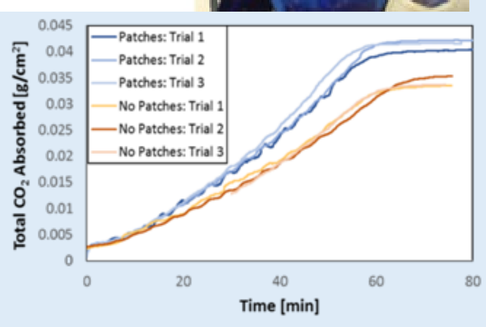
Liquid/Gas contact in conventional packing

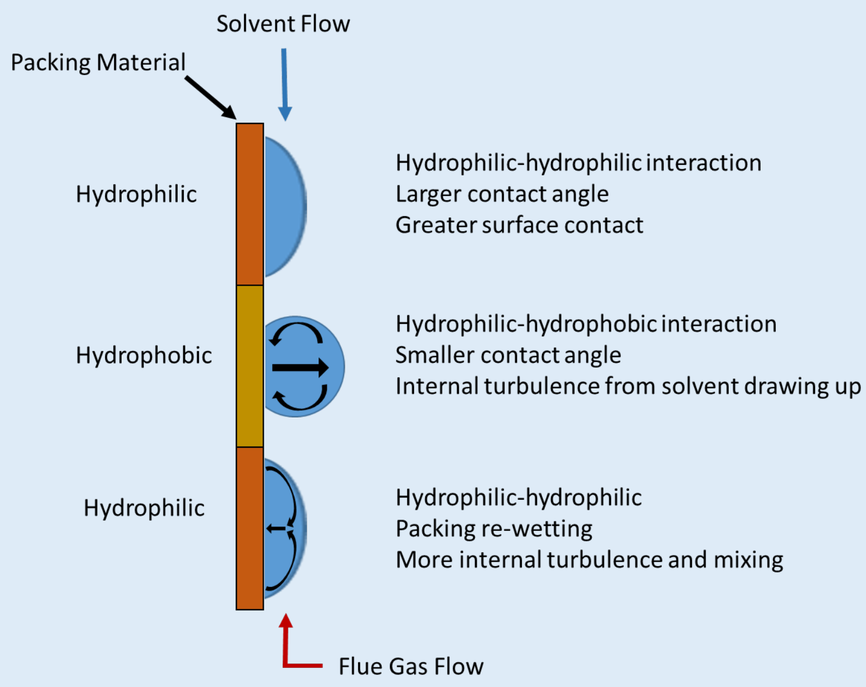




Liquid flow across hydrophilic (top) and hydrophobic (bottom) surfaces

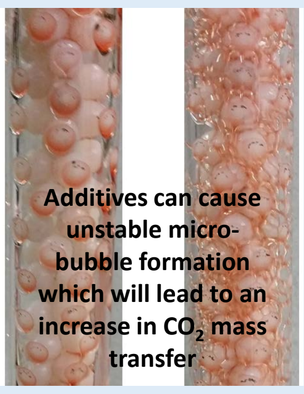






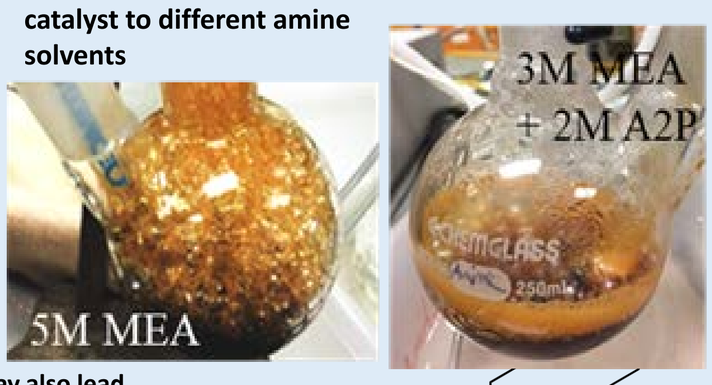
Understanding solvent physical properties and the impact of additives

Investigate the impact of additives on the physical properties of solvent and their relationship to bubble formation to boost mass transfer while reducing aerosol formation

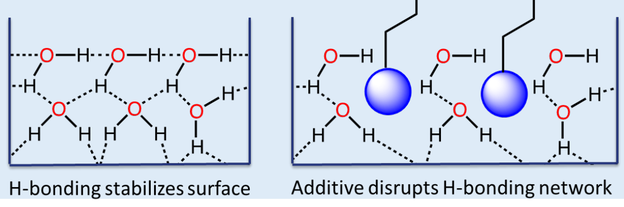


Additives can cause unstable micro-bubble formation which will lead to an increase in CO_2 mass transfer

Changes in bubble formation behavior upon addition of catalyst to different amine solvents



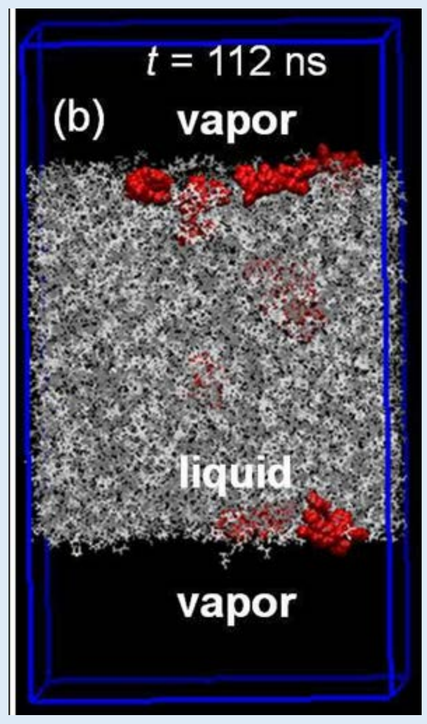
Other types of additives may also lead to changes in physical properties
- Anti-corrosion compounds
- Anti-foam agents
- Oxidation inhibitors
- Physical property modifiers
- Catalysts



H-bonding stabilizes surface

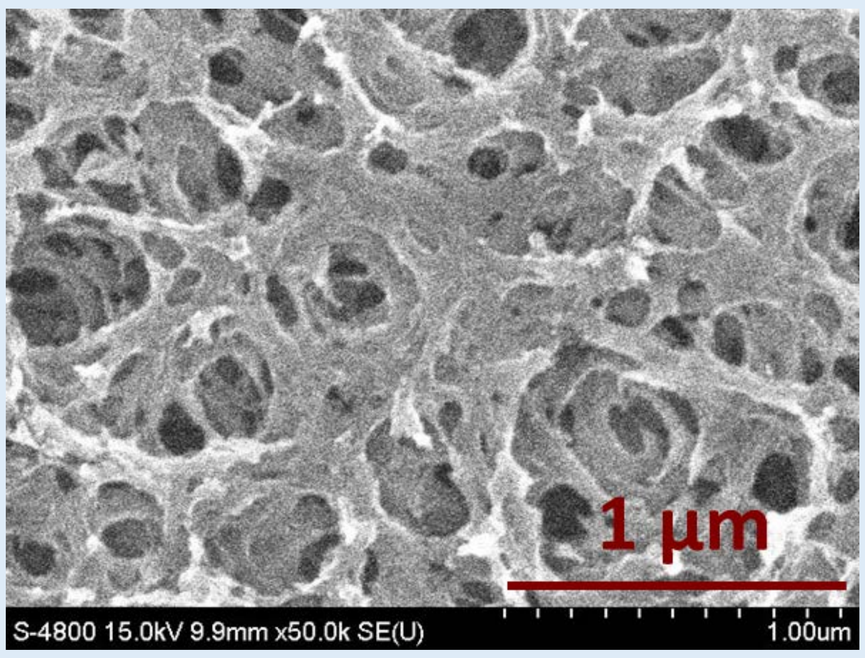
Additive disrupts H-bonding network

Additives may not be homogeneous when added to amine solvents. Additives (red) can cluster on the surface changing the surface tension of the solvent leading to bubble formation



Electrochemical decomposition of nitrosamines

Neutralize nitrosamines derived from amine solvents through development of an electrochemical treatment process



UKy-CAER developed Carbon Xerogel (CX) is a type of mesoporous electrode material

CX has an approximate surface area of 150 $m^2\ g^{-1}$ with a high adsorption capacity towards nitrosamine compounds

CX shows excellent chemical stability, conductivity, native ion-adsorption capability, and solvent wettability

Project Goals

Emission Side: Develop better ways to control environmental contaminants from escaping CCS systems

Solvent Side: Develop a better understanding of how to manipulate the physical properties of solvents to improve surface wetting, increase mass transfer, and achieve the performance of advanced solvents at significantly lower costs

Packing Side: Develop lower cost column packing to increase mass transfer at the gas-liquid interface using additive manufacturing

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