Global Challenges of Capturing Carbon Dioxide

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It is now widely accepted that climate change is one of the most important global challenges that we face [1]. What is also widely accepted is that no single solution is available, but a concerted effort should be made to try and limit the impact of global warming by switching to renewable energy generation and reducing emissions of carbon dioxide and other greenhouse gases. These are not new concepts, especially if one considers that more than 20 years have passed from the Kyoto protocol of 1997 [2].

While most of the focus has been on reducing emissions from electricity generation, much less emphasis has been given to the fact that these emissions typically represent only one third of the overall emissions and with further growth of renewable electricity generation this fraction is bound to decrease. The real challenge lies in decarbonizing transport, industry and distributed heating, all of which represent systems that are very different from large scale thermo-electric power plants.

Within this general context, this talk will consider the use of novel nanoporous materials as the basis for adsorption based separations [3] that will range from concentrated mixtures to direct capture of carbon dioxide from air. An overview of different classes of materials will show how these can be tailored to such a wide range of conditions. The sheer scale of the task leads to having to optimize systems and speed up processes, which in turn brings in diffusion limitations.

The final part of the talk will highlight the different types of diffusion mechanisms [4] that impact on carbon capture separations. This is a very rich field if one takes into account the range of novel materials that have been developed in the last 15 years and of particular interest are materials that undergo structural flexibility during adsorption. The discussion will focus on how to exploit diffusion limitations to enhance selectivity towards carbon dioxide and also when diffusion limitations should be minimized.

References

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