CO_2 absorption of aqueous MEA and DEA solutions studied by Ambient Pressure X-ray Photoelectron Spectroscopy

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CO_2 capture is a promising approach to reduce/prevent CO_2 emission from fossil fuel power plants and thus contributing to the efforts of deterring the global warming related to the greenhouse effect. To selectively separate CO_2 from flue gases the currently most viable solution is chemisorption with amine-based solutions. As part of the thermal swing CO_2 capture process, the amine sorbents capture CO_2 at temperatures below 60° C and release it at temperatures above 100° C regenerating the sorbent, which then can be reused in the next cycle.

However, amine loss due to oxidation or thermal degradation and a more energy and cost-efficient capturing procedure are among the challenges that have to be overcome before commercialization [1]. Therefore, insights into the CO_2 absorption process on a molecular basis and an understanding of the chemical equilibrium of aqueous amine with newly formed species from the CO_2 reaction are required.

Liquid jet ambient pressure X-ray photoelectron spectroscopy (APXPS) experiments are suitable to investigate the crucial vapor/liquid interface where the absorption processes are occurring. The energy tunability of the synchrotron source enables the determination of the present and formed chemical species directly at the interface and in the near surface region of the sample solution, showing the depth dependence of the individual species and the variation in chemical composition.

We have studied primary and secondary type amine solutions, i.e. 30 wt% aqueous Monoethanolamine (MEA) and Diethanolamine (DEA) solutions with varying CO_2 loadings at beamline 11.0.2 of the Advanced Light source (ALS) using APXPS combined with a colliding liquid flat jet system. Our results give new insights into the quantity of the CO_2 absorption products at low and high CO_2 loadings and their tendency for the interface or bulk of the solution.

[1] Dutcher B. et al., *ACS Appl. Mater. Interfaces*, **7, 4**, 2137-2148 (2015)