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MEA decay mediated by photolysis of nitrate in atmospheric particles: a brown carbon and organic phase formation pathway

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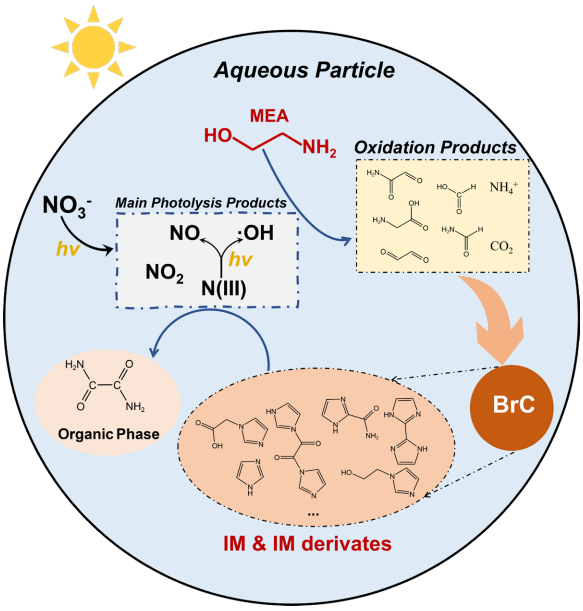

The massive release of monoethanolamine (MEA) into the atmosphere from power industries highlights MEA as a potential environmental risk. NO_3^- is one of the most abundant inorganic compounds and has been found to co-exist with amines in ambient particles. Photolysis of NO_3^- can produce oxidants, which lead to the particulate MEA decay. Furthermore, MEA degradation products are likely to possess the BrC formation potential due to the formation of carbonyl species. Here, we investigated the aging of MEA-containing particles mediated by NO_3^- photolysis. Particles under different RH and initial pH conditions were irradiated at 300 nm. After reactions, the more acidic particles show an increase in pH, while the neutralized particles show a decrease in pH. We attributed these contrary pH changes to the combined results of the HONO evaporation which increases the pH against MEA reactions which decreases the pH. NO_3^- and MEA decay rates are more sensitive to the initial pH than RH. Unlike the linear decay trends at all RH for the neutralized particles, NO_3^- and MEA in more acidic particles decay rapidly in the first few hours but followed by a slower linear decay. MEA reaction mechanisms in the presence of oxidants produced from NO_3^- photolysis were proposed by combining with the quantum chemistry computations and speciation of the products. Furthermore, water-soluble BrC and an organic phase were formed as potential SOA. This study reveals the particulate MEA sink and its potential on BrC and SOA formation mediated by NO_3^- photolysis in the atmosphere, which may give a new insight into the aging of amine in the atmospheric aerosols.