Electrically-driven separation of proteins and flavour molecules

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Separation processes are essential for the production of purified ingredients and the recovery of valuable components from waste streams. Classic thermal- and chemical-based separation techniques often require harsh conditions and extensive amounts of energy, especially when (dilute) liquid streams are processed. To reduce the environmental impact, novel sustainable separation techniques should be developed, such as electrically-driven separation.

Electrically-driven separation relies on switching of the interaction between a target molecule and a material surface (the electrode) when the direction or the strength of an applied electric field is changed. We apply the principle of capacitive deionization to separate larger biomolecules, such as proteins and flavours, and improve the separation capacity and selectivity by designing electrically-responsive polymer coatings. These coatings alter their characteristics in response to an external electric field, for example by (de)protonation, collapsing, swelling, internal restructuring, or changing their exposed groups on the surface. Consequently, the chemical functionality, charge and/or wettability of the material are affected, and interaction forces with target molecules are impacted. By removing the electric field stimuli or changing their direction, the original properties of the material are regained. This “switching behaviour” allows precise control over the interaction between the polymer coatings and target molecules and therewith enables selective adsorption and desorption.

This research focuses on the development of electrically responsive polymer coatings and studies their switching behaviour. The chemical and structural functionality of these novel materials and their capacity and selectivity in adsorption and desorption of proteins will be reported. The preliminary results show a positive proof of concept.