Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting information to the research paper "An integrated electrochemical process to convert lignin to value-added products at mild conditions"

Behaviour of lignin polydispersity of Kraft lignin at a foamstack electrode

Fig. SI 1 shows the polydispersity index (PDI) of Kraft lignin during electrochemical depolymerization at different currents at a nickel foamstack electrode. From an initial PDI of around 7, the value increases in the first 45 minutes of the reaction to values between 14 and 18, depending on applied current. Subsequently, the PDI decreases to a minimum value between 1 and 2.2 after 1050 minutes of reaction. A similar trend was also observed for the felt and the single foam electrode. Thus, the PDI of lignin can be controlled to a certain degree.

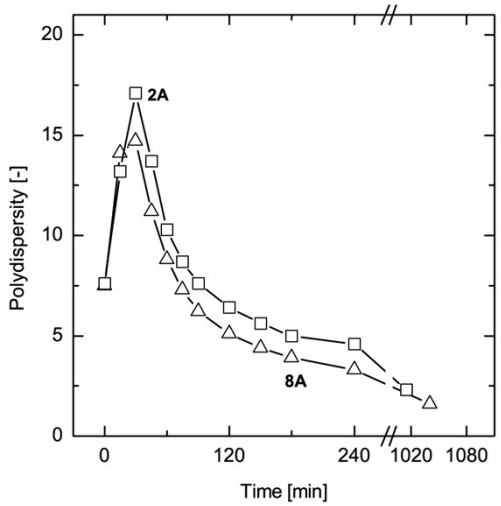

Fig. SI 1 Lignin polydispersity during the electrochemical depolymerization of lignin at a nickel foamstack electrode.

Relative molecular weight of kraft lignin in relation to electrode area

Fig. SI 2 shows the relative molecular weight after 90 minutes of electrochemical depolymerization at different electrode materials and current densities. There is no clear correlation between the depolymerization degree and the electrode are. Even though plate and wire have similar electrode areas, at the wire electrode extensive polymerization can be observed. Similarly, foam and felt exhibit differing areas but show similar depolymerization.

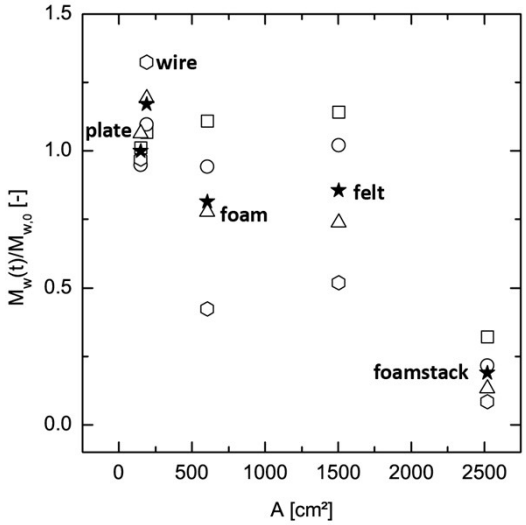

Fig. SI 2 Relative molecular weight of kraft lignin after 90 minutes of electrochemical cleavage in relation to electrode area A. The white symbols depict the cleavage at 2, 4, 6 and 8A (square, circle, triangle and hexagon, respectively) whereas the black stars depict the average across all applied currents. There is no clear correlation between electrode area and the depolymerization degree.

Lignin and vanillin retention of the HFS membrane

Fig. SI 3 shows measured retention of lignin and vanillin as a model compound for different crossflow and transmembrane volume flows. Retention was quantified via UV/vis absorbance measurements. In accordance with filtration theory, higher crossflow velocities and a lower transmembrane flux leads to higher retention values. In general, lignin retention of the utilized membranes is rather high with all values ranging over 93%. Vanillin retention ranges from around 15 to slightly over 30%.

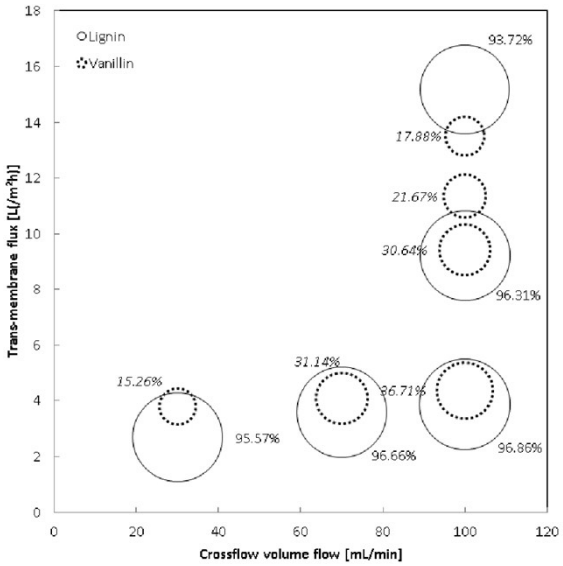

Fig. SI 3 Lignin and vanillin retention of the utilized HFS membranes depending on crossflow and transmembrane volume flow.

SEC measurements of lignin retention without applied current

Fig. SI 4 shows the reference run to fig. 8 without applied current. Measured molecular weight cut off is 1.7 kDa.

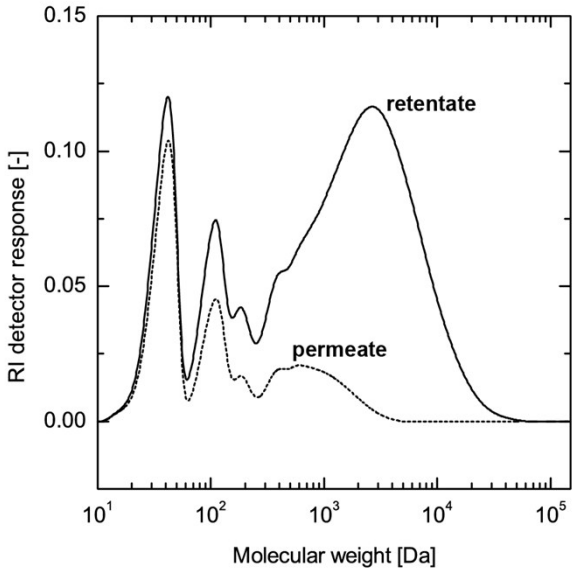

Fig. SI 4 SEC chromatograms of retentate and permeate of the reference run of the combined electrochemical depolymerization and subsequent filtration without applied current