Titel:

Software development and modeling of pressure- and electrically driven liquid chromatography in etched pillar arrays

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Korte inhoud:

In a wide variety of disciplines, like for instance, biology, chemistry, genetics and many more, the chromatographic separation of interesting components out of a sample mixture is probably one of the most used analytical tools. Because of the great importance and ever increasing demand in highly efficient chromatographic systems, a continuous effort is being made to improve this technique. A possible path towards improvement is the use of perfectly etched pillar columns. Since the etching process allows a wide variety of design parameters, it will be very cost-effective and time-saving to use computer calculations to predict the performance of theoretical column designs. In this work, a simulation tool which is able to predict the chromatographic performance of a theoretical column under pressure- and electrically driven conditions is presented. This software model is used to investigate the fluid- and concentration fields, explaining the difference in column performance when pressure or voltage is applied and/or when different pillar shapes are used. The obtained data also provides important insights in what kind of performance that can be expected under extreme pressure/voltage conditions and future enhancements. Furthermore, the tool is used for more fundamental research investigating the effect of the retention factor and intra-pillar diffusivity on the performance together with a detailed study of the validity of the Giddings additive law which is the backbone of the general plateheight model used in chromatography. To conclude, an effort has been made to present a semi-analytical formulation for the band broadening in pillar array columns which holds under all investigated conditions.