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Mechanism of DNA Trapping in Nanoporous Structures during Asymmetric Pulsed-Field Electrophoresis[1] YA ZHOU, D. JED HARRISON, Univ of Alberta — DNA molecules (>100kbp) are trapped in separation sieves when high electric fields are applied in pulsed field electrophoresis, seriously limiting the speed of separation. Using crystalline particle arrays, to generate interstitial pores for molecular sieving, allows higher electric fields than in gels, (e.g 40 vs 5 V/cm), however trapping still limits the field strength. Using reverse pulses, which release DNA from being fully-stretched, allows higher fields (140 V/cm). We investigate the trapping mechanism of individual DNA molecules in ordered nanoporous structures. Two prerequisites for trapping are revealed by the dynamics of single trapped DNA, hernia formation and fully-stretched U/J shapes. Fully stretched DNA has longer unhooking times than expected by simple models. We propose a dielectrophoretic (DEP) force reduces the mobility of segments at the apex of the U or J, where field gradients are highest, based on simulations. A modified model for unhooking time is obtained after the DEP force is introduced. The new model explains the unhooking time data by predicting an infinite trapping time when the ratio of arm length differences (of the U or J) to molecule length $\Delta x/L < \beta$. β is a DEP parameter that is found to strongly increase with electric field.

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Ya Zhou
Univ of Alberta

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