Microfluidic Temperature Gradient Focusing

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In the past year, we have developed a new method for concentrating and separating ionic species in a microfluidic system based on their electrophoretic mobilities. In this method called Temperature Gradient Focusing, a temperature gradient is created along the length of a buffer-filled microchannel that produces a gradient in the electrophoretic velocity of an analyte in that channel. When the bulk fluid flow in the opposite direction is tuned to match the electrophoretic velocity of the analyte at some point in the gradient, the analyte becomes immobile and focuses at that point. We have demonstrated this effect using electroosmotic flow and pressure driven flow as the opposing bulk fluid flow. Two or more ionic species with different electrophoretic mobilities will focus at different points in the microchannel due to the fact that the electrophoretic velocity will match the bulk velocity at a point in the gradient that is directly related to the mobility. In this method, the temperature gradient can be imposed externally by heating or cooling the microfluidic channel on a temperature-controlled surface. Alternatively, a temperature gradient can be created by altering the geometry of the microfluidic channel to produce variations in Joule heating along the length of the channel with an applied electric field. We have demonstrated the application of this technique for the separation of small molecules including fluorescent dyes, large biopolymers including DNA and proteins, as well as particles and whole cells.

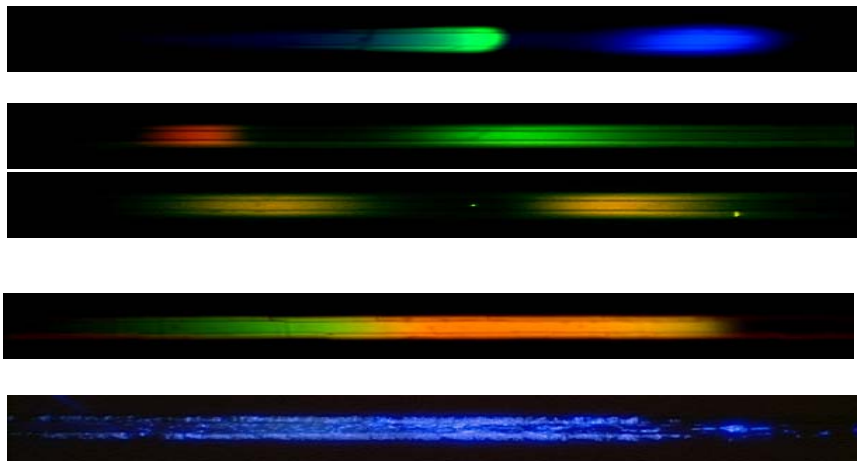

Figure 1. Fluorescence images showing separations of various analytes using TGF.