3-dimensional paper-based microfluidic device for programming multi-step assays

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Paper-based microfluidic device is strongly promised as a diagnostic tools in developing countries, where are lack of electricity, refrigeration and trained medical teams. However, conventional methods require external instruments such as a pump to control moving of fluids for a sequential reaction. This limitation is critical for practical uses in developing countries. In this study, we demonstrate a simple approach for flow control in a 3-dimensional paper-based device that is applicable for multi-step assays. First, a wax-printer prints patterns on a paper by using different waxes. Then, the printed-wax-patterns forms microfluidic channels by melting of waxes through a laminator. In this step, the height of channel is easily controlled by viscosity of waxes. The microfluidic channels with different heights allow sequential insertion of controlled volumes of dissolvable reagents in 3D-microfluidic space. It does not require any instruments to control velocity of fluid in a paper for programming multi-step assays. Therefore, we expect that this approach could be an instrument-free assay format for use in developing countries.