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Can a flow be turbulent in microfluidics with Reynolds number in the order of 1? GUIREN WANG, FANG YANG, WEI ZHAO, University of South Carolina — Traditionally, it is believed that turbulence occurs in relatively high Re number flow. For instance, the critical Re number is about 2100 in a pipe flow. Although there can be elastic turbulence in low Re, it is conventionally believed that the flow in mirofluidics, where typical Re is in the order of 1 or less, can only be laminar. Here, we demonstrate that features of turbulent flows can be achieved in a microchannel with Re in the order of 1, when the flow is electrokinetically forced. To measure the flow velocity, we developed a confocal microscopic velocimeter with high tempo-spatial resolution, i.e. molecular tracer based Laser Induced Fluorescence Photobleaching Velocimeter. We measured the general features in turbulent flows: fast diffusion or mixing, irregular flow velocity, high dissipation rate, 3-D flow and continuous power spectrum of velocity fluctuation indicating multiscale structures of small eddies. Interesting is that a -5/3 power spectrum with about one decade span in frequency is also observed. The results indicate that turbulence can be realized as well in microfluidics with Re in the order of 1. The study could open a new perspective view on turbulence and transport phenomena in microfluidics.

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