

Abstract

Microfluidics technology has a lot of promise in Lab on chip, drug discovery and combinatorial chemistry applications. However, progress in many applications is hampered by the lack of a scalable, low cost and reliable valve technology. Pneumatically actuated valves have been the mainstay of microfluidic valve technology but are hard to scale and require a supply of compressed air. This dissertation focuses on the design, fabrication, and testing of a piezoelectric microvalve integrated with microfluidics through a transfer process. Firstly, a comprehensive study on lead-free materials like P(VDF-TrFE), potassium sodium niobate (KNN), and barium titanate (BaTiO_3) is undertaken. Various methods to create thin films, such as drop casting, spin coating, and screen printing, are explored. A low-temperature process to fabricate the valve using screen printing has been developed using a nanocomposite paste using BaTiO_3 nano powder and ethyl cellulose. Finally, a straightforward low-temperature drop-casting method was utilized to fabricate piezoelectric microvalves using composite-1. The microvalve testing results are encouraging and hold significant promise for advancing microfluidic technologies and laboratory automation. In summary, this dissertation work provides a novel approach to the fabrication of a piezoelectric microvalve and its integration with microfluidics using the transfer in a facile manner.