fluid mixture flow through the column by provision of an acoustic standing wave at one end of the column that can prevent the support structures from passing.

An aspect of the present disclosure provides a separation system, comprising an expanded bed column with an opening on each end to permit a fluid flow therethrough, and an acoustic transducer on one end of the column for generating an acoustic standing wave in the column. The acoustic transducer is configured to generate the acoustic standing wave to block or permit passage of material entrained in the fluid flow.

Another aspect of the present disclosure provides a method for separating materials, comprising providing support structures in an expanded bed column for binding with a first material; flowing a fluid mixture that includes the first material into the column; and generating an acoustic standing wave with an acoustic transducer near an end of the column to block the support structures from leaving the column with the fluid flow.

Another aspect of the present disclosure provides an acoustic affinity separation method, comprising: providing affinity beads in a fluid to a column; generating an acoustic standing wave with an acoustic transducer near an end of the column; flowing a cellular material fluid mixture in the column and through the acoustic standing wave; configuring the acoustic standing wave to prevent the affinity beads from passing through the acoustic standing wave.

In some examples, methods, systems, and apparatuses are disclosed for separation of biomaterials accomplished by functionalized material distributed in a fluid chamber that bind the specific target materials. The specific target materials can be particles, including cells, recombinant proteins and/or monoclonal antibodies. The functionalized material, which may be beads and/or microcarrier structures are coated or otherwise provided with an affinity material for attracting and binding the specific target materials. The affinity material may be a protein, ligand or other material that can form a bond with the target material.

In some example implementations, the affinity material and the target material can form antigen-antibody interactions with binding sites on the functionalized material. In some instances, the target material become bound to the functionalized material when a ligand of the target material or the functionalized material is conjugated to a matrix on the complementary material. The functionalized material includes functionalized microbeads. The functionalized microbeads include a particular antigen ligand that has affinity for a corresponding antibody.

In some examples, material adhered to the support structures with the functionalized material remains in the column, while other free material in the fluid may pass through the acoustic standing wave to provide separation of materials. The support structures may be implemented to have a certain acoustic contrast factor based on their density, compressibility, size or other characteristics that permits the support structures to react more strongly to the acoustic standing wave than other materials in the fluid mixture.

The support structures may be agitated in the column to enhance the affinity process. In different modes, the column fluid mixture that passes through the acoustic standing wave can be recirculated to the column or not. The fluid flow in the column can be controlled to flow or not, and when flowing, the rate of flow can be controlled. The fluid may be stationary in the column and may have other processes applied thereto, such as temperature adjustment, agitation, incubation, and/or any other useful process. The volume of the column can be effectively modified, such as with the provision of a plunger or piston in the column. Heating or cooling can be applied to the column or the contents of the column, internally or externally to the column.