Microfluidic Device for Portable Oxygen Generators

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We have developed a conceptual design for a portable oxygen generator that uses microchannel adsorbent beds and microfluidic pumps and valves. Our device offers an efficient oxygen generator with reduced overall size and weight.

A portable oxygen generator would allow patients to receive medical oxygen without sacrificing their mobility. However, developing a device that is small enough to be portable is challenging with conventional technology. Our work has shown that combining microchannel adsorbent beds, microfluidic pumps, and microfluidic valves makes a very small and portable device possible. The device would operate using a cyclic process known as pressure swing adsorption (PSA). In the first step of a PSA cycle, pressurized air is pumped into an adsorbent bed, nitrogen is selectively adsorbed in the bed, and oxygen is produced. In the second step, the pressure of the adsorbent bed is lowered and the bed regenerated. The overall size and weight of a portable oxygen generator depends on the cycle time, or how quickly the cycle can be completed.

Using a microchannel adsorbent bed and microfluidic pumps and valves, we can decrease the cycle time and thus the overall size and weight of the generator. The microchannel adsorbent bed allows cycle time to be decreased by improving mass transfer to the adsorbent. Microfluidic pumps and valves allow the cycle time to be decreased by reducing the time required to change the direction of gas flow. In addition, microfluidic pumps and valves improve system reliability and flow distribution in the adsorbent bed, two factors that have plagued the development of short cycle-time devices with conventional technology.

Our poster will present our conceptual design for the portable oxygen generators and solicit ideas for constructing such a microdevice.