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Ionic liquid-coated alumina-pretreated micro gas chromatography columns for high-efficient separations

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Highlights

- Room temperature ionic liquids were deposited on alumina-pretreated microcolumns
- Approximately two-fold improvement in separation efficiency was observed
- The plate numbers as high as 8,000 plates per meter were obtained
- Peak production rate of as high as 1.1 peaks per second was observed
- The columns were used for the separation of fatty acid methyl esters in biodiesel

Abstract

These studies demonstrate the influence of an intermediate layer of aluminum oxide on the separation performance of a room temperature ionic liquid (RTIL)-coated gas chromatography silicon microcolumn. A 1-m long semi-packed column having 190-µm wide and 240-µm deep rectangular cross-sectional channels with embedded arrays of micro pillars was microfabricated. A thin layer of alumina was then deposited on the surface of the channels via atomic layer deposition. Following the alumina deposition, the channels were coated with an RTIL. The separation performance of the RTIL-coated columns with and without the alumina layer was evaluated by measuring the separation efficiency and peak capacity. A substantial increase in separation efficiency was observed in the presence of the alumina layer. The alumina-pretreated columns, at optimum flow rate, exhibited as high as 8,000 plates per meter, which is a 2.1-fold increase as compared to the column with no alumina layer. It is inferred that alumina coating promotes the formation of a more uniform RTIL film, thereby enhancing the separation efficiency. The peak production rates of alumina-RTIL columns for temperature-programmed separation were found to be 0.80 to 1.1 peaks per second, which is an improvement compared to silicon-RTIL columns. The separation performance of these columns were further evaluated by separating a standard 21-component mixture of hazardous organic compounds, a sample of kerosene, diesel, and B20 biodiesel.. These studies open up new possibilities of enhancing the separation efficiency of microcolumns by coating silicon surface with a suitable material prior to depositing an ionic liquid.

Keywords
Micro GC; Separation columns; Atomic layer deposition; Alumina; Ionic liquids; Plate number;