some embodiments 20% or less) of the residence time of gas in the adjacent heat exchanger. An schematic illustration is shown in **FIG. 4**.

[0120] In some embodiments, less than 50% of the area of a reaction channel is coated with a catalyst wall coating. In some embodiments, the ODH reaction is conducted at a temperature above 700° C., and less than 50% of the area of a reaction channel that is at a temperature above 700° C. is coated with a catalyst wall coating.

[0121] Preferably, selectivity to carbon oxides (on a carbon atom basis) is less than 40%, more preferably less than 20% (in some embodiments, in the range of 20% and 5%), and even more preferably less than 5%. In less preferred embodiments, selectivity to carbon dioxide (on a carbon atom basis) is less than 40%, more preferably less than 20% (in some embodiments, in the range of 20% and 5%), and even more preferably less than 5%.

[0122] The CO/CO_2 ratio is indicative of the efficiency of the ODH process; low ratios indicate that oxygen was unavailable for ODH and was consumed primarily for combustion. In a microchannel reactor we are capable of obtaining CO to CO_2 ratios in excess of those predicted at equilibrium for the particular gas mixture in question when the reactor temperature is below the temperature at which the formation of CO is favoured over the formation of CO_2. For example when the ratio of C3 to O2 is 2:1 and the total pressure is 10 psig the temperature at which CO and CO_2 are at a 1:1 ratio at equilibrium is approximately 660° C. below this temperature the formation of CO is strongly favored by thermodynamics.

[0123] For a given mixture at a given operating pressure the CO:CO2 ratio obtained in a microchannel reactor when the temperature is below that where the formation of CO is thermodynamically favorable and is preferably at least 2.4:1 or more preferably 2.76:1 or more preferably 4.6:1 or even more preferably 10:1.

[0124] At equal peak temperatures the volumetric productivity as defined by the grams of target olefin (for example propylene) produced per unit volume of reaction chamber (reaction chamber is that portion of a channel where catalyst is present either as flow-by or flow-through) per hour is greater in a microchannel than in a conventional reactor. As shown in the examples, when the C3 to O2 ratio was 1:1 and the peak temperature was about 625° C. the productivity of the microchannel is greater than that of a quartz tube by a factor of 1.9. Volumetric productivity of a microchannel reactor performing propane ODH could in one instance be 15 g/ml/hr or preferably 30 g/ml/hr or more preferably 60 g/ml/hr or even more preferably 120 g/ml/hr or more, in some embodiments productivity is 15 to about 150 g/ml/hr.

[0125] In the case of ethane ODH, at equal average temperatures, the productivity as defined by the grams of target olefin (for example ethylene) produced per unit mass of catalyst of catalyst per hour is greater in the microchannel than in a conventional reactor. Productivity of a microchannel reactor performing ethane ODH is preferably at least 270 g/g/hr or more preferably at least 600 g/g/hr or more preferably 1200 g/g/hr or even more preferably at least 2400 g/g/hr.

[0126] In some preferred embodiments, H_2 is recovered from product gas and at least a part of the recovered H_2 is fed back to the reactor.

[0127] The percent conversion of hydrocarbon (in a single pass) is preferably 50% or higher, more preferably about 70% or higher, even more preferably 80% or higher. The level of percent selectivity to desired product or products in the case where more than one valuable alkene can be formed, is preferably at least 50% preferably at least 60%, and in some embodiments 50 to about 93%. The yield of product alkene or alkenes and/or aralkene in mol % per cycle is preferably greater than 10%, and more preferably greater than 20%. The total yield of product alkene or alkenes and/or aralkene(s), in mol %, is preferably greater than 50%, more preferably greater than 75%, and most preferably greater than 85%. The specified levels of conversion, yield and selectivity should be understood as exemplary and include all values such as yield per cycle of at least 15%, at least 25%, etc. as well as ranges such as 10 to 30%. The ranges and conditions can be further understood with reference to the Examples and the invention includes all ranges and minimum levels of conversions, etc. described therein. It is also envisioned that routine testing and experimentation, in view of the teachings provided herein, will reveal superior results and it is therefore intended that this disclosure be broadly interpreted to include descriptions of numerous levels (and ranges) of conditions and results.

[0128] For ODH of ethane, selectivity to ethene (ethylene) is preferably 80% or more, more preferably 85% or more, and in some embodiments in the range of 80 to about 93%, more preferably 84 to about 93%. In some embodiments, the sum of ethene and ethyne selectivity is preferably 80% or more, more preferably 85% or more. These selectivities are based on a single pass through a reactor.

[0129] Oxygen conversions of greater than 90%, greater than 95%, most prefereably greater than 99% can be achieved with gas flow rates of greater than 10,000 h-1, greater than 100,000 h^{-1} and even greater than 1,000,000 h-1 in an oxidative dehydrogenation process in a microchannel reactor.

EXAMPLES

[0130] Direct Coating Methodology:

[0131] On a heat treated aluminidized alloy 617 coupon, aqueous metal solution used as precursors was directly applied at room temperature. For the Pt system, 9% (atomic Pt) of tetraammineplatinum hydroxide solution was used. After each coating, the coupon was calcined at 450° C. for 1 hr in air. Once the desired weight gain was achieved, the coupon was calcined at 850° C. for 4 hrs in air for the final calcination. For a Re—Pt system, perrhenic acid or ammonium perrhenate can be used and was coated first before Pt was applied.

[0132] Corrosion Protection

[0133] Samples of Inconel™ 617 were corrosion tested with and without a protective aluminide coating. The aluminide coated sample was made by forming a layer of aluminide and heating under H2 atmosphere and then exposing to air at 1050° C. Both samples were corrosion tested at 960° C. and 17% water, 2.5% O_2 for 1000 hours. The uncoated sample showed pitting after 100 hours of testing. In contrast, the aluminide/alumina coated sample showed no observable change after 1000 hours of corrosion testing. See **FIG. 1**, which shows no damage to the alumina layer. The