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more reactants or mixtures thereof into the catalyst or solid at the top of the sample chamber that uniformly spans the length and width thereof.

4. The probe of claim 1, wherein the introduction tube includes a spray nozzle at an end thereof configured to spray the carrier gas containing the one or more reactants or mixtures thereof uniformly into the at least three inlets.

5. The probe of claim 1, wherein the outlets below the sample chamber include an orientation that is other than centrally disposed to prevent the one or more reactants or mixtures thereof introduced at the top of the sample chamber from channeling through the bottom of the sample chamber at the low differential pressure.

6. The probe of claim 1, wherein the end plugs are comprised of a ceramic or a plastic.

7. The probe of claim 1, wherein the introduction tube in the first (top) end plug and the exit tube in the second (bottom) end plug are centrally disposed therein and configured to remain stationary as the MAS rotor rotates.

8. The probe of claim 1, wherein the MAS rotor includes containment members disposed above and below in contact with the sample chamber to contain the catalyst or solid therein.

9. The probe of claim 8, wherein the containment members include or are composed of glass wool.

10. The probe of claim 1, wherein the introduction tube couples to a gas inlet disposed external to the rotor that delivers the carrier gas containing the one or more reactants or mixtures thereof into the rotor.

11. The probe of claim 10, wherein the gas inlet couples to a programmable syringe pump or one or more mass flow controllers that delivers the carrier gas containing the one or more reactants or mixtures thereof into the rotor at a constant rate or in a pulsed mode.

12. The MAS rotor of claim 1, wherein the exit tube in the spin tip couples operatively to a GC-mass spectrometer that determines composition and reaction dynamics of volatile reaction products generated in-situ in the sample chamber of the MAS rotor.

13. A magic angle spinning (MAS) nuclear magnetic resonance (NMR) rotor for NMR investigations in situ, the rotor comprising:

a sample chamber with an internal volume greater than or equal to about 0.01 cm³ configured to contain and rotate a catalyst or a solid therein;

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a first (top) end plug disposed above the sample chamber comprising an introduction tube that couples to at least one inlet, the at least one inlet is configured to deliver one or more reactants or a mixture thereof in a carrier gas to a catalyst or a solid introduced within the sample chamber at a pressure at or above atmospheric pressure;

a second (bottom) end plug disposed below the sample chamber comprising an exit tube that couples to at least three outlets, the outlets are configured to collect one or more reaction products when released from the catalyst or solid within the sample chamber at a pressure below atmospheric pressure; and

a spin (drive) tip disposed below the second end plug through which the exit tube from the second end plug extends, the exit tube couples to a vacuum pump or device disposed external to the rotor that maintains a differential pressure between the inlets and outlets within the rotor to deliver the one or more reaction products collected in the at least three outlets from the rotor as the rotor rotates.

14. The MAS rotor of claim 13, wherein the introduction tube includes a spray nozzle at an end thereof configured to spray the carrier gas, the reactants, or mixtures thereof uniformly into the at least one inlet.

15. The MAS rotor of claim 13, wherein one of the at least one inlets is centrally disposed.

16. A method for performing high resolution magic angle spinning (MAS) NMR investigations in situ, comprising the steps of:

providing the NMR probe according to claim 1 spinning the catalyst or the solid within the sample chamber in the MAS rotor at a selected rotation speed;

flowing one or more reactants or mixtures thereof in the carrier gas into the catalyst or solid within the sample chamber at a pressure at or above atmospheric pressure to convert the reactants therein to one or more reaction products; and

acquiring NMR spectra as a function of time as the reactants are flowed into the catalyst or solid; and

analyzing reactions occurring within the catalyst or solid within the sample chamber in situ as a function of the flow-in time of the reactants as reaction products are collected from the sample chamber at a pressure below atmospheric pressure.

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