VANDERBILT UNIVERSITY

CTTC Center for Technology Transfer & Commercialization

PANACEA Para-hydrogen Polarizer

Summary

The heart of a conventional PASADENA polarizer is an efficient system for circulating and reacting chemicals in the presence of static and applied magnetic fields. In a general preparation, gaseous and liquid chemicals must be stored, mixed, heated, filtered, and delivered to reactors. These events should expose the associated molecules to minimal surface area, allow rapid movement between isolated reservoirs, and deliver constant levels of polarization on successive trials. These requirements are universally satisfied when dead-volume is negligible compared to the reaction volume. If the transit surface area is 10% of reaction volume, and the entire surface is contaminated, then the experimental performance will be proportionally reduced up to 10%. When molecules encounter increased surface area in transit to the reactor, performance falls while system response latency rises with inefficiency. Under these circumstances, expensive catalyst and reactants are distributed across the apparatus, and the experiment meant for the reactor is instead deposited on the walls of the apparatus.

The present invention provides a PANACEA ("Pneumatics Allow Nonmagnetic Actuation for Creation of Enhanced Alignment") polarizer system. This is an integrated assembly of pneumatically actuated, nonmagnetic hydraulic circuits that enable PASADENA chemicals to be efficiently stored, mixed, and reacted in close proximity or within NMR magnetic fields. In contrast to conventional PASADENA polarizers, reactants are located at minimal separation to the reaction chamber, and therefore surface area between the chemical holding reservoirs and the reaction chamber can be made arbitrarily small in comparison to the reaction volume. This creates an upper bound on the deleterious impact that accrues from chemical deposits on the walls of the apparatus between the reservoir and the reaction chamber, and the reactor walls are refreshed after each cycle.

Advantages

- Central electronic control over all experimental variables in a pulse programming environment familiar to MR scientists
- Low field enhancements in excess of 5,000,000
- High throughput operation – hundreds of experiments routinely possible per day
- More compact than conventional spray polarizers
- Minimal dead volume

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