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(54) **DISCRETE MAGIC ANGLE TURNING SYSTEM, APPARATUS, AND PROCESS FOR IN SITU MAGNETIC RESONANCE SPECTROSCOPY AND IMAGING**

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See application file for complete search history.

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(57) **ABSTRACT**

Described are a "Discrete Magic Angle Turning" (DMAT) system, devices, and processes that combine advantages of both magic angle turning (MAT) and magic angle hopping (MAH) suitable, e.g., for in situ magnetic resonance spectroscopy and/or imaging. In an exemplary system, device, and process, samples are rotated in a clockwise direction followed by an anticlockwise direction of exactly the same amount. Rotation proceeds through an angle that is typically greater than about 240 degrees but less than or equal to about 360 degrees at constant speed for a time applicable to the evolution dimension. Back and forth rotation can be synchronized and repeated with a special radio frequency (RF) pulse sequence to produce an isotropic-anisotropic shift 2D correlation spectrum. The design permits tubes to be inserted into the sample container without introducing plumbing interferences, further allowing control over such conditions as temperature, pressure, flow conditions, and feed compositions, thus permitting true in-situ investigations to be carried out.

**49 Claims, 11 Drawing Sheets**

