Magnetic Resonance Imaging of Local Flow Velocity in Porous Media

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Magnetic Resonance Imaging (MRI) has considerable potential as a non-destructive probe of fluid behaviour in porous media, offering the possibility of visualizing flow phenomena and rapid quantification of local fluid content. Realistic porous media are challenging samples for traditional clinical MRI methods and require specialized material science oriented imaging techniques.

In this work we explore a general approach to measuring spatially resolved fluid velocity in realistic porous media undergoing flow. Measurements are based on the SPRITE MRI methodology [(1)] with pulsed magnetic field gradient velocity weighting as a magnetization preparation. The new method permits facile flow and dispersion coefficient mapping of fluids in porous media. The new approach has proven be very robust and efficient in characterizing fluid behavior and permits velocity measurement in porous systems heretofore inaccessible to MRI.

The method is illustrated through flow measurements in sand packs and reservoir core plugs. Both spatially resolved flow maps and local fluid velocity distributions can be acquired. A simple extension of the measurement permits determination of spatially resolved permeability in heterogeneous samples. Combining velocity information with spatially resolved fluid content measurements will permit novel enhanced oil recovery techniques to be studied and evaluated.

References

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