



Noninvasive Characterization of Mechanical Properties of Materials and Tissue using Magnetic Resonance Techniques

Key Investigator

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Field

MRI
 NMR
 Diagnostic

Technology

Magnetic Resonance
 Elastography

Advantages

A non-invasive method for determining the mechanical property of a material or human tissue.

Status

Available for licensing

Patent Status

US Patent 9,348,008

UMB Docket Reference

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External Reference

Soft Matter. 2011; 7(21)
 9890.

Summary

Many diseases alter the mechanical properties of tissue. Accordingly, the mechanical properties can serve as biomarkers for disease, diagnosis, and tumor assessment. While some larger diseased tissues or abnormalities near the surface of a patient can be detected by palpitation, many are located deep within the patient or too small to identify. Some indications include liver fibrosis or other growths inside the thoracic cavity. A non-invasive means for detecting mechanical properties of patient tissue would provide physicians with a reliable tool to diagnose and monitor diseased tissue.

Technology

Viscoelastic materials (complex fluids) exhibit the elastic properties of solids as well as the viscous flow characteristics of fluids in response to shearing stresses. The study of the mechanical properties of viscoelastic materials is known as 'rheology.' Rheo-NMR uses nuclear magnetic resonance (NMR) to measure the fluid flow response to deformational stresses.

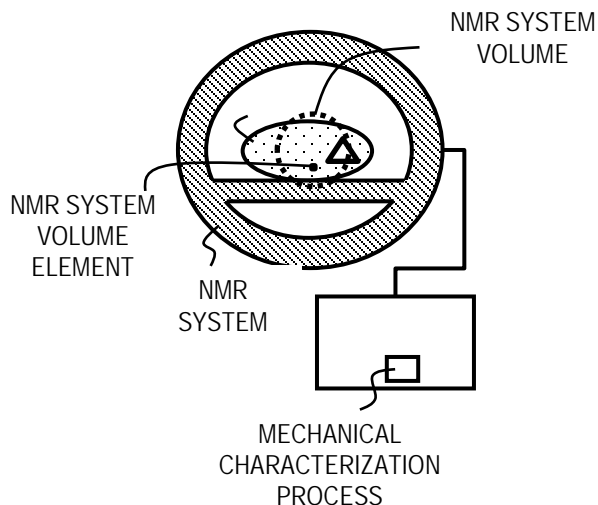


Figure 1: Block Diagram illustrating an example system of the invention

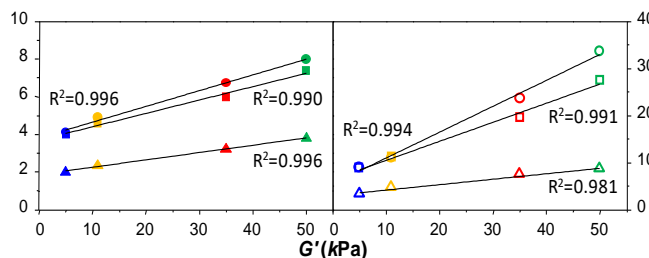


Figure 2: Dependence of NMR relaxation rates on mechanical properties of hydrogels

Magnetic Resonance Elastography (MRE) is one non-invasive method for detecting mechanical properties in a tissue in the field of Rheo-NMR. MRE mechanically excites the tissue by introducing shear waves through ultrasound. Nuclear Magnetic Resonance Images (MRI) of the propagation of the shear waves are taken. Specific mathematical algorithms are used to interpret the images and generate quantitative images depicting tissue stiffness.

Technology Status

The technique has been demonstrated in several model systems.