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Three-dimensional Deformable Pore Networks

J. Conrad and L. J. Pyrak-Nolte
Department of Physics and Astronomy, Purdue University, West Lafayette, IN 47907

Abstract

Porous structures in materials play a part in many areas of research and development. A couple of examples of this are extraction of water through aquifers and oil through fracking processes. Current understanding of the small scale fluid-fluid interactions in the structure of these porous materials stops at data of the two dimensional interface between the two fluids. This experiment aimed to create three dimensional, transparent, deformable micro-models which are expected allow us to obtain three dimensional data sets of the capillary pressure–saturation–interfacial area per volume relationship. The micro-models were synthesized using a grain deposition technique. Grains were formed using the polymerization of a 5% (v/v) solutions of Irgacur 1173 initiator in poly (ethylene glycol) diacrylate when the solution is exposed to patterns of ultraviolet light (in the range of 435nm to 485nm). These grains are layered in a pre-made plain channel micro-model to create a complex but transparent porous structure. Initial imaging using laser confocal microscopy shows that these micro-models can be used to study three dimensional interactions between fluids in porous structures. Through the creation of these three dimensional micro-models we now have a better way to experimentally model porous materials found in nature which offers many topological possibilities for applications in rock, biology, oil, water, and even food science research.

Keywords

Geophysics, Hydrology, Micro-models, UV polymerization

References

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