Determining Oil Well Connectivity Using Nanoparticles

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SUMMARY

UCLA researchers in the Department of Chemistry have developed a method of using nanowires to detect underground fluid reservoir interconnectivities and reservoir contents with high accuracy.

BACKGROUND

Most conventional systems for studying the extent of wells and flow into and out of them require the use of dyes or radioactive tracers. They rely on sophisticated detection equipment, such as laser spectroscopy, and often require that samples be sent to labs. These systems are limited to general flow detection, and cannot identify the chemical nature of the reservoir's contents. The tracing materials used present health hazards, can degrade on use, and can adhere to the walls of reservoirs. Moreover, these tracers do not provide information on the well interconnection diameter. Therefore, a need exists to develop systems and methods that allow for more accurate determination of the connectivity between wells and their contents.

INNOVATION

UCLA researchers have developed a method of using imageable metal nanowires to uniquely label the contents of underground wells and tanks and detect connections between reservoirs. UCLA's technology allows for real-time, automated determination of reservoir connectivity and the chemical contents of the reservoir by using metal nanowires designed with affinity for specific compounds. These nanowires were simulated in metallic barcode-like tracer analysis that use optical techniques and yielded accuracy rates of 98%, even in poor optical conditions. Imaging methods and analysis algorithms can measure well dimensions and interconnection diameters on the sub-micron level. Moreover, the nanoparticles can be functionalized for a wide variety of characteristics, including increased hydrophobicity or lipophilicity.

APPLICATIONS

- Oil well leakage detection
- Water table flow monitoring
- Tracer elements for enhanced oil/gas recovery
- Oil/gas/water flow meter calibration
- Cardiovascular mapping for early cardiovascular disease diagnosis

ADVANTAGES

- Potential of accuracy rates of 98%
- Can measure well interconnection diameters on the sub-micron level
- Automated reservoir connectivity detection in real time
- Easily functionalized for a variety of characteristics to identify reservoir contents.
- No need to introduce chemicals or radioactive materials into wells
- Each well can be labeled with a unique nanowire

STATE OF DEVELOPMENT

- Nanowire fabrication method has been demonstrated
- Scale-up is expected to show that large batches can be produced relatively inexpensively
- Imaging methods and algorithms have been demonstrated in the lab
- Next step is to test the method in the field

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INVENTORS

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OTHER INFORMATION

KEYWORDS

tracer, nanotracer, nanoparticles, metallic nanowires, oil well connectivity, waterflooding, oil field, oil reservoir, oil extraction, oil recovery

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Computer**
  - Software
- **Energy**
  - Hydrocarbon
- **Nanotechnology**
  - Other
  - Tools and Devices
- **Sensors & Instrumentation**
  - Environmental Sensors
  - Other
  - Physical Measurement

RELATED CASES

2014-866-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,620,107	04/14/2020	2014-866

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Multiple-Patterning Nanosphere Lithography
- High-Throughput Intracellular Delivery of Biomolecular Cargos via Vibrational Cell Deformability within Microchannels
- Scalable Lipid Bilayer Microfluidics for High-Throughput Gene Editing
- Guided Magnetic Nanospears For Targeted And High-Throughput Intracellular Delivery
- High-Throughput Microfluidic Gene-Editing via Cell Deformability within Microchannels

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