

Технічні науки

**Trofymovska Yuliia**

*Entrepreneur*

*Kharkiv National University of Internal Affairs of the*

*Ministry of Internal Affairs of Ukraine*

## **WATER AND MILK QUALITY CONTROL AND MONITORING IN SMART HOME INFRASTRUCTURE**

**Summary.** *Inventions in the Field of Contactless Control and Monitoring of Drinking Water and Cow's Milk Quality in the Ecosystem and Infrastructure of a Smart Home*

*Introduction.* The quality of drinking water and milk in the infrastructure of a smart home essentially determines the quality of life. In all methods of quality control for water and milk, conductivity is commonly considered a clear indicator of purity. The more contaminants there are in water or milk, the lower its electrical resistance, and the cleaner the water or milk, the higher its electrical resistance.

*This was acceptable for a long time, until international terrorism reached its current level of proliferation, and until overall environmental pollution reached unprecedented scales and dimensions, as it is today.*

*Purpose.* These are certainly not all the factors that justify the urgent need for more comprehensive quality control of water or milk, but they are very important ones.

*Almost all existing technologies, devices, and equipment for monitoring the quality of water or milk have a very narrow range of technical capabilities and do not cover all the parameters that need to be constantly monitored. This is necessary to ensure that water or milk, which, due to the aforementioned reasons,*

*is contaminated to the extent that it poses a danger to human life and health, does not reach the consumer.*

**Key words:** *Smart Home, Smart Home Ecosystems, Smart Home Infrastructure, Drinking Water, Milk, Real-time Monitoring of Drinking Water Quality Status, Real-time Monitoring of Milk Quality Status, Parameters of Resonance Phenomena, Comprehensive Digital Indicator of Dynamic Water State.*

**Introduction.** Inventions in the Field of Contactless Monitoring of Drinking Water and Cow's Milk Quality

The quality of drinking water essentially determines the quality of life. In all methods of water quality control, it is commonly accepted that the conductivity of water is a clear indicator of its purity. The more contaminants there are in water, the lower its electrical resistance; the cleaner the water, the higher its electrical resistance.

For a long time, this approach was sufficient, until international terrorism reached the level of widespread proliferation that we see today, and until overall environmental pollution reached unprecedented scales and proportions.

These are certainly not all the factors that justify the urgent need for more comprehensive quality control of water, but they are very important ones. Almost all existing technologies, devices, and equipment for water quality control have a very narrow range of technical capabilities and do not cover all the parameters that need to be continuously monitored, so as not to allow water contaminated to the point of posing a danger to human life and health to reach consumers.

Milk is one of the most important products in a balanced diet, and since a significant percentage of its composition is also water, it requires equivalent, mobile, reliable, and accurate control technology, adapted both to the increased quality requirements for milk and to the new regulatory standards for quality.

When monitoring milk quality, adaptation to new technological conditions and processes of industrial processing is also very important.

Based on this incomplete set of information, it can be reasonably concluded that constant monitoring of the quality of milk and water before use is essential. Such technologies have been invented, and below is a brief description of these technologies

*Device for Selective Real-Time Identification of the Comprehensive Digital Indicator of the Dynamic State of Drinking Water Quality*

The device is a compact unit designed to operate as part of water pipeline systems, in water flow meters, or in field conditions with solar panel power supply. The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control, and transformation of the water flow. The water flow transformation system includes an aerodynamic mechanism for removing gases from the specified flow.

The device may be configured for stationary applications or for express analysis.

The device and its operation do not require special training for the operator or user.

*Device for Real-Time Monitoring of Cow's Milk Quality*

The device is designed for real-time monitoring and evaluation of the current value of the comprehensive digital indicator of the dynamic state of cow's milk quality.

The Comprehensive Digital Indicator of the Dynamic State of Cow's Milk is an integral parameter that, based on criteria such as frequency, amplitude, resistance, inductance, and a set of dynamic characteristics of the milk flow, serves as an integral equivalent of the current values of the content and concentration of components in cow's milk, including the biological connections between these components.

The device for selective real-time identification of the milk quality indicator is a compact unit designed to operate in a dairy farm environment or in field conditions with solar panel power supply.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control, and transformation of the milk flow. The milk flow transformation system includes an aerodynamic mechanism for removing gases from the milk flow.

The device may have configurations for stationary applications as well as for express analysis.

Comprehensive Integral Indicator of Water and Aqueous Solution Quality and Device for Its Real-Time Identification

The digital indicator of the dynamic state of drinking water quality, which compares the pulse directed into the sensor based on criteria such as frequency, amplitude, resistance, inductance, and the same parameters generated in the pipeline due to resonance phenomena in the flow, in combination with the set of dynamic characteristics of the water flow, serves as an integral equivalent of the current values of the content and concentration of components in the water.

The device for selective real-time identification of this indicator is a compact unit designed to operate in urban or main water supply systems, or in field conditions with solar panel power supply.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control, and transformation of the water flow being monitored. The system for transforming the water flow includes an aerodynamic mechanism for removing gases from the flow.

The comprehensive integral water quality indicator also includes a comprehensive integral sensor indicator, which for each type of sensor, its design parameters, and the signal supplied to the sensor, is a constant value. This has

been confirmed by a series of tests conducted over more than 1000 cycles on 4 types of sensors.

The device can be configured for stationary applications as well as for express analysis.

**Comprehensive Integral Indicator of Cow's Milk Quality and Device for Its Real-Time Identification**

The digital indicator of the dynamic state of cow's milk, based on criteria such as frequency, amplitude, resistance, inductance, and a set of dynamic characteristics of the milk flow, serves as an integral equivalent of the current values of the content and concentration of components in cow's milk.

The device for selective real-time identification of this indicator is a compact unit designed to operate in dairy farm conditions or in field conditions with solar panel power supply.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control, and transformation of the milk flow. The system for transforming the milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for express analysis.

**Dynamic Comprehensive Indicator of the Current Fat Concentration in Cow's Milk and Device for Its Selective Real-Time Identification**

The digital indicator of the dynamic state of cow's milk, based on criteria such as frequency, amplitude, resistance, inductance, and a set of dynamic characteristics of the milk flow, serves as an integral equivalent of the current value of fat or fatty acid content and concentration in cow's milk.

The device for selective real-time identification of this indicator is a compact unit designed to operate in dairy farm conditions or in field conditions with solar panel power supply.

The device has minimal energy consumption.

The device includes functionally interconnected systems for input, output, control, and transformation of the milk flow. The system for transforming the milk flow includes an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for express analysis.

### **List of references, patent and license information**

**United States Patent** **10,732,237**  
**Slobozhanyuk , et al.** **August 4, 2020**

Magnetic resonance imaging machine

### **Abstract**

The invention relates to medical diagnostics and can be used in magnetic *resonance* imaging and magnetic *resonance spectroscopy* for increasing the quality of diagnostics of the internal organs of humans and animals. By virtue of a metamaterial, which is used as an *electromagnetic* field amplifier, being made from a set of advantageously oriented conductors, it becomes possible to spatially rearrange magnetic and electric fields operated at radio frequencies. In particular, in the examined object area, the radio frequency magnetic field is resonantly amplified, which makes it possible to increase the signal/noise ratio in MRI and to obtain better quality images and/or to perform the MRI examinations more quickly as there is no need to accumulate the signal. The proposed design of the metamaterial makes it possible to distance the radio frequency electric field from the area where the examined object is located, therefore enhancing safety of MRI scanning.

**United States Patent** **10,564,308**  
**Godoy, et al.** **February 18, 2020**

Electron paramagnetic resonance (EPR) techniques and apparatus for performing EPR spectroscopy on a flowing fluid

### Abstract

Certain aspects of the present disclosure provide methods and apparatus for performing electron paramagnetic *resonance* (EPR) *spectroscopy* on a fluid from a flowing well, such as fluid from hydrocarbon recovery operations flowing in a downhole tubular, wellhead, or pipeline. One example method generally includes, for a first EPR iteration, performing a first frequency sweep of discrete *electromagnetic* frequencies on a cavity containing the fluid; determining first parameter values of reflected signals from the first frequency sweep; selecting a first discrete frequency corresponding to one of the first parameter values that is less than a threshold value; activating a first *electromagnetic* field in the fluid at the first discrete frequency; and while the first *electromagnetic* field is activated, performing a first DC magnetic field sweep to generate a first EPR spectrum.

United States Patent  
Wang

9,952,297  
April 24, 2018

Parallel plate transmission line for broadband nuclear magnetic resonance imaging

### Abstract

A parallel plate waveguide forms a volume coil used for magnetic *resonance* imaging and *spectroscopy*. The waveguide includes a first conductor arranged on a first side of the waveguide and a second conductor arranged on a second side of the waveguide. Excitation of the first conductor and the second conductor creates a transverse *electromagnetic* field between the first conductor and the second conductor which causes a target within the volume coil to emit radio frequency signals used for producing an image of the target.

United States Patent  
Hetherington, et al.

9,316,709  
April 19, 2016

Transceiver apparatus, system and methodology for superior In-Vivo imaging of human anatomy

## Abstract

The inventive subject matter as a whole is an improved transceiver apparatus and system for diagnostic evaluations of living subject, human or animal; and is particularly effective as a clinical tool for the spectroscopic scanning or magnetic *resonance* imaging of humans suspected of being afflicted with a particular disease, disorder, or pathology. The improved transceiver apparatus is used as an essential component in a computer controlled system suitable for magnetic *resonance* imaging ("MRI"), or nuclear magnetic *resonance spectroscopy* ("MRS"), and/or nuclear magnetic *resonance* spectroscopic imaging ("MRSI"); and the present improvement of these *electromagnetic* signaling systems will provide far more accurate and precise visual images and accumulated data for the clinician or surgeon, as well as serve as a basis upon which to make a diagnosis and decide upon a mode of therapeutic treatment for that individual.

United States Patent  
Yonamoto, et al.

9,018,954  
April 28, 2015

Sample holder for electricity-detection electron spin resonance device

## Abstract

A sample holder structure is provided with which it is possible to reduce current noise derived from *electromagnetic* induction, etc. in electricity-detection electron spin *resonance spectroscopy*. Also provided is a process for producing the structure. The material of the sample holder, which is used in an electricity-detection electron spin *resonance* device, is an FR-4 resin, alumina, glass, or Teflon. The sample holder has four wiring leads formed on the surface thereof. The four wiring leads each has a three-layer structure composed of a nickel layer, a gold layer, and a resist layer which have been arranged in the order from the sample holder surface, and the sample holder has the shape of the letter T. The sample holder has, formed in the end thereof, a gold pad for affixing a sample, and the gold pad has a multilayer structure composed of a nickel layer and a gold layer arranged in this order from the sample holder surface. In the T-shaped head part of the sample holder, the four wiring leads are spaced wider from each other.



**United States Patent**  
**Neu, et al.**

**8,884,608**  
**November 11, 2014**

AFM-coupled microscale radiofrequency probe for magnetic resonance imaging and spectroscopy

### **Abstract**

The present disclosure is discloses the development of a new device, system, and method that combines advantages of magnetic *resonance* and atomic force microscopy technologies, and the utility of the new device, system, and method for a wide range of biomedical and clinical researchers. According to one aspect of the present disclosure, a device for micro-scale *spectroscopy* is disclosed. The micro-scale *spectroscopy* device includes a beam having a distal end, a proximal end, a top surface and a bottom surface, where the beam is attached to an anchor at the proximal end and further includes a tip extending substantially perpendicular from the bottom surface at or near the distal end, and a coil having at least one turn mounted to the top surface of the beam at or near the distal end opposite the tip, where the coil is capable of both transmitting and sensing *electromagnetic* radiation.

**United States Patent**  
**Tang, et al.**

**8,780,344**  
**July 15, 2014**

Waveguides configured with arrays of features for performing Raman spectroscopy

### **Abstract**

Embodiments of the present invention are directed to systems for performing surface-enhanced Raman *spectroscopy*. In one embodiment, a system for performing Raman *spectroscopy* includes a waveguide layer configured with at least one array of features, and a material disposed on at least a portion of the features. Each array of features and the waveguide layer are configured to provide guided-mode *resonance* for at least one wavelength

of *electromagnetic* radiation. The *electromagnetic* radiation produces enhanced Raman scattered light from analyte molecules located on or in proximity to the material.