

Editorial

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The scientific contributions in this special issue of FREQUENZ summarizes the results of the second phase of the Priority Program “Electromagnetic Sensors for Life Sciences: New sensor concepts and technologies for biomedical analysis and diagnostics, process- and environmental monitoring”, SPP1857, acronym: **ESSENCE**, which has been established in 2014 by the Senate of the „Deutsche Forschungsgesellschaft, DFG“ (German Research Foundation).

The central idea of the Priority Program ESSENCE is to foster interdisciplinary research in the field of electromagnetic sensors, whose principle of sensing or measurement is based on the interaction between the electromagnetic fields of the sensor and the matter to be detected or analyzed with a special focus on biomolecules, cells, tissues or other relevant substances in life sciences.

Besides the practical application in the fields of medicine, biology, pharmacology, food chemistry, agricultural engineering and environmental analysis/monitoring, which reach from clinical through point-of-care applications to laboratory- and on-site diagnostics, there is a special interest in fundamental research as well, for example in molecular biology and toxicology. The social relevance of this subject arises from the high potential to directly increase the quality of life through faster, easier and more precise ways of analysis and diagnostics. Beyond that, it might enable new forms of treatments as well.

The scientific mission of ESSENCE is the basic multi-disciplinary research of new principles, concepts and technologies of electromagnetic sensors in the range of microwaves, millimeter waves or terahertz (300 MHz up to 10 THz). The sensor classes under consideration range from single, dedicated sensors through sensor arrays to complex multifunctional sensors, partly in combination with new dedicated surface functionalization for

electromagnetic transducers in the stated frequency range. This includes new research approaches for detection and observation of specific organic and inorganic molecules. Furthermore, the observation of isolated cells and cell cultures is of high relevance, for example in the field of (human) biological and medical test series as commonly used in basic research as well as in applied analytics and diagnostics and for plant protection. Lastly, these sensors are means to characterize large unit cell structures and biological tissues, for example to prevent and to treat cancer, for mobile medical on-site treatment or manifold minimally invasive diagnostic procedures in the clinical area such as vascular diagnosis for assessing the risk of a heart attack.

In the framework of this DFG Priority Program SPP 1857, particularly scientific projects have been promoted with research approaches in the field of electromagnetic sensors for microwaves, millimeter waves or terahertz, which combine the following topics:

- Dedicated sensor structures with optimized selectivity and/or sensitivity
- Non-invasive or minimal invasive sensors for diagnostics
- EM sensor based/supported medical treatment methods
- In- and ex-vivo characterization methods for biological tissues and tissue differences as well as for medically relevant substances
- Techniques to handle very small sample volumes in combination with specifically designed sensors or sensor arrays
- Tailored biological, chemical or physical surface functionalization for electromagnetic transducers
- Characterization of electromagnetic properties of healthy and pathologically altered cells, biological tissues and substances in biology and medicine (in-as well as ex-vivo) and chemical substances, for example in the field of environmental and food diagnostics
- Basic research of biological processes on a molecular level using electromagnetic sensors

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These topics have been handled in multi- and interdisciplinary projects, involving researchers from different disciplines such as electrical engineering, physics, biology and medicine. The results of the different interdisciplinary projects in the second phase of **ESSENCE** are summarized in this current special issue of **FREQUENZ**

similar to the one of the first phase, released in March 2018.

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