

## HiMi-ESR – High frequency micro probe for ESR

An on-chip integrated micro probe developed at the institute of electronics delivers a low cost and very portable ESR system part.

### Motivation

Electron spin resonance (ESR) is a powerful spectroscopic tool, which has been used for over 50 years in physics, chemistry, biology, medicine, and materials science in order to study the structure, dynamics, and spatial distribution of parametric species. ESR spectroscopy, combined with other techniques, can be used to detect and follow free radical reactions in biological systems.

Conventional inductive ESR approach is the most widely used method due to its high versatility. Unfortunately, imaging of ultra small scale structures (single crystal proteins, single cells, mono-layers of bio molecules, etc.) via this approach requires special setups and is not always feasible. Miniaturized inductive ESR systems are needed.

Such systems have recently been introduced. Use of on-chip micro coils in ESR probes has been successfully demonstrated. These devices showed sensitivity figures close to their larger equivalents and present attractive alternatives due to their low costs, portability, and small sizes.

There are still several challenges for the miniaturization of ESR systems. Micro coil and other high frequency electronic parts (PA, VCO, mixer, etc.), that form a basic inductive ESR probe, should be integrated on a single chip to unleash the advantages and power of miniaturization.

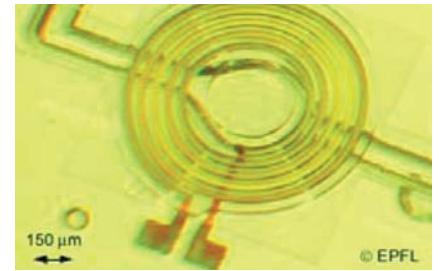
### Description

Within the scope of this project, an X-band (9 GHz) microprobe for electron spin resonance applications will be developed. High frequency electronic components that form an ESR probe will be integrated on a single chip or multi-chip-module. The project will be executed in the following steps:

- A high frequency/microwave and microelectronics design and development environment will be established within IfE.
- Existing structures with the same or similar functionality will be investigated. Their advantages and drawbacks will be determined. Alternative micro coil structures and microwave electronic circuits will be designed and verified via simulation and/or prototyping.
- Developed micro coil and microwave electronics will eventually be integrated and prototyped. This final prototype will be used in practical ESR applications for performance evaluation.

### Results

Successful completion of this project will provide an ESR microprobe, which will lead to cost-effective desktop ESR systems. Introduction of such systems will turn ESR into a widely available and cheap spectroscopy tool, and may lead to new and unforeseen applications of ESR.



**Project**  
HiMi-ESR

**Project Partners**  
Ecole Polytechnique Fédérale de  
Lausanne, CH-Lausanne  
[www.epfl.ch](http://www.epfl.ch)

**Project Duration**  
12 (+24) months

**Project Budget**  
CHF 93'000

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