Towards Smaller NQR Spectrometers and NQR Detection Devices

[1]Beguš S., [2]Jazbinšek V., [2]Pirnat J., and [2]Trontelj Z.

[1]Faculty of Electrical Engineering University of Ljubljana, Ljubljana, Slovenia

[2]Institute of Mathematics, Physics and Mechanics, Ljubljana, Slovenia

NQR spectroscopy has proved already in the middle of previous century to be able to detect the nitrogen (^{14}N) nuclear quadrupole resonance. Practically all ^{14}N NQR lines are below 5 MHz and therefore it is difficult to achieve a high enough signal-to-noise (S/N) ratio for any practical application, like the detection of illicit materials. In the last 10, 15 years, some new approaches appeared [1, 2, 3] and S/N ratio was improved to this extent that presently we can non-invasively detect the most important illicit materials reasonably fast in the laboratory environment.

The requirements of today are directed towards the low power ^{14}N NQR spectrometer that may lead to the multi-channel NQR device which will be able to rapidly detect several illicit materials. We will present and discuss this type of low frequency NQR spectrometer based on the micro-electronic components. We have constructed a NQR spectrometer using the available Universal Software Radio Peripheral (USRP) platform [4], the Field-Programmable Gate Array (FPGA), high speed analog-to-digital (AD) and digital-to-analog (DA) converters together with the LabView [5] software support. This way we have built a single channel pulsed ^{14}N NQR spectrometer of around 2 kg mass and working with the maximal RF power of 5 W. A note-book PC is needed for communication with this spectrometer and for data acquisition and analysis. We were able to detect all usual explosives (including the Trinitrotoluene-TNT) and improvised explosives in reasonable measuring time. A multi-channel detection device, based on the detection of ^{14}N NQR seems to be a feasible project.

[1] Seliger et al., J. Magn. Reson. **106** (1994) 214
[2] V.S. Grechishkin and N.J. Sinjavsky, Physics – Uspekhi **40** (1997) 393
[3] Janko Lužnik et al., Appl. Phys. Lett., **89** (2006) 123509
[4] www.ettus.com/product/details/UN200-KIT
[5] www.ni.com/labview/