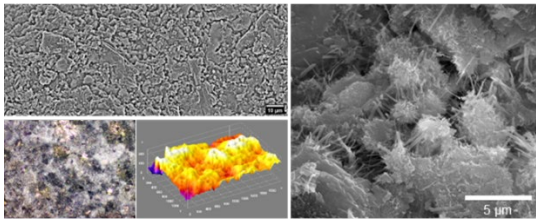


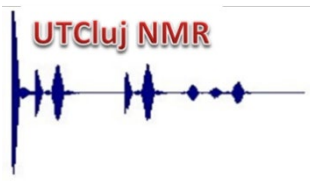


NUCLEAR MAGNETIC RESONANCE DIFFUSOMETRY AND RELAXOMETRY LABORATORY

Contact details

Name	Nuclear Magnetic Resonance Diffusometry and Relaxometry Laboratory	<p style="text-align: center;">Porous, cementitious composites</p>  <p style="text-align: center;">Bruker MINISPEC MQ20 FFC NMR Stelar SMARtracer</p>  <p style="text-align: center;">Complementary equipment</p> 
Acronym	NMRDR	
Logo		
Site	https://nmr.utcluj.ro/	
Address	Bulevardul Muncii, nr.14, rooms 28 and 31 (et. III), Cluj-Napoca, Romania	
Faculty Department	Faculty of Materials and Environmental Engineering Physics and Chemistry Department	
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Areas of expertise

NMR diffusometry and relaxometry techniques are implemented to investigate the dynamics of liquid molecules at the interface of porous media and under confinement conditions. The confining pores of the investigated systems may have sizes ranging from nanometres to micrometres and may be entirely or partially saturated with fluids. The investigations can be done at different temperatures and resonance frequencies. The porous systems currently under study are porous glasses, carbon-based materials, colloidal crystals, polymeric nanocapsules used in controlled drug delivery, cement-based materials, bone cements, porous ceramics with magnetic impurities, biomaterials with applications in medicine, magnetic nanoparticles used as contrast agents in magnetic resonance imaging. Other materials which can be studied in our laboratory: woods, fuel cell membranes, lubricants, fuels, catalysts, zeolites, ionic liquids, liquid crystals, rubber. Using NMR relaxometry and diffusometry techniques in the investigation of fluids confined inside porous media it is possible to extract information about pore dimensions and their connectivity. Other information that can be extracted refers to the ageing and alteration processes of different materials such as rubber, polymers, lubricants or food. In our laboratory we are also interested in developing of new NMR techniques suitable for the investigation of systems with a high content of magnetic impurities (concrete, rocks, soils, different building materials).

Team

Prof. dr. Ioan Ardelean, Asist. dr. Mihai Marius Rusu, Amalia Taut, Karoly Mostis, Adrian Mateas.

Representative projects

PN-III-P4-ID-PCE-2020-0533 (4.01.2021-31.12.2023): New cement-based nanocomposite materials for 3D printing applications; <https://pce23.weebly.com/>.
PN-III-P2-2.1-PED-2016-0719 (4.01. 2017-30.06.2018): Developing and testing of a new concrete, with higher flexural strength, obtained through the addition of nanoparticles and organosilane; <https://ped125.weebly.com/>.
PN-II-ID-PCE-2011-3-0238 (1.03. 2011-15.12.2016): Nuclear magnetic resonance studies of surface effects on dynamics of molecules confined inside porous media with magnetic impurities; <https://idei305.weebly.com/>.
CEEX MATNANTECH (1.03.2006-30.12.2008): NMR studies of molecular dynamics inside polymeric nanocapsules.
INSTITUTSPARTNERSCHAFT UTCN-Technical University Ilmenau, Germany (2011-2014): Molecular dynamics during the phase transition of liquids confined inside porous media (joint project financed by the Alexander von Humboldt foundation).

Significant results

The most representative publications of the past 5 years:

1. A. Crețu (Bede), C. Mattea, S. Stapf, I. Ardelean, The effect of silica fume and organosilane addition on the porosity of cement paste, *Molecules* 25 (8), 1762 (2020), <https://doi.org/10.3390/molecules25081762>
2. C. Cadar, A. Crețu, M. Moldovan, C. Mattea, S. Stapf, I. Ardelean, NMR T1–T2 correlation analysis of molecular absorption inside a hardened cement paste containing silanized silica fume, *Molecular Physics* 117, 1000-1005 (2019), <https://doi.org/10.1080/00268976.2018.1513582>
3. C. Cadar, I. Ardelean, Surface influence on the rotational and translational dynamics of molecules confined inside a mesoporous carbon xerogel, *Magnetic Resonance in Chemistry* 57 (10), 829-835 (2019) <https://doi.org/10.1002/mrc.4819>
4. F Gallego-Gómez, C Cadar, C Lopez, I Ardelean, Microporosity Quantification via NMR Relaxometry, *The Journal of Physical Chemistry C* 123 (50), 30486-30491(2019), <https://doi.org/10.1021/acs.jpcc.9b10398>
5. F Gallego-Gómez, C Cadar, C López, I Ardelean, Imbibition and dewetting of silica colloidal crystals: An NMR relaxometry study, *Journal of colloid and interface science* 561, 741-748(2020), <https://doi.org/10.1016/j.jcis.2019.11.050>
6. A. Nan, M. Suci, I. Ardelean, M. Senila, R. Turcu, Characterization of the Nuclear Magnetic Resonance Relaxivity of Gadolinium Functionalized Magnetic Nanoparticles, *Analytical Letters* 54, 124-139 (2021), <https://doi.org/10.1080/00032719.2020.1731522>
7. J Stepišnik, I Ardelean, A Mohorič, Molecular self-diffusion in internal magnetic fields of porous medium investigated by NMR MGSE method, *Journal of Magnetic Resonance* 328, 106981 (2021), <https://doi.org/10.1016/j.jmr.2021.106981>
8. I. Ardelean, The Effect of an Accelerator on Cement Paste Capillary Pores: NMR Relaxometry Investigations, *Molecules* 26 (17), 5328 (2021), <https://www.mdpi.com/1420-3049/26/17/5328>
9. L.M. Nicula, O. Corbu, I. Ardelean, A.V. Sandu, M. Iliescu, D. Simedru, Freeze–Thaw Effect on Road Concrete Containing Blast Furnace Slag: NMR Relaxometry Investigations, *Materials* 14 (12), 3288 (2021), <https://doi.org/10.3390/ma14123288>
10. M. Oztop Berkay Berk, C. Cavdaroglu, L. Grunin, I. Ardelean, D. Kruk, G. Mazi, Use of Magic Sandwich Echo and Fast Field Cycling NMR Relaxometry on Honey Adulteration with Corn Syrup, *J. Science of Food and Agriculture*, 2021, <https://doi.org/10.1002/jsfa.11606> .
11. I. Lacan, M. Moldovan, C. Sarosi, I. Ardelean, Chitosan Effect on Hardening Dynamics of Calcium Phosphate Cement: Low-Field NMR Relaxometry Investigations. *Polymers*. 2022; 14(15):3042, <https://doi.org/10.3390/polym14153042>
12. M.M Rusu, D. Faux, I. Ardelean, Monitoring the Effect of Calcium Nitrate on the Induction Period of Cement Hydration via Low-Field NMR Relaxometry, *Molecules*, 2023, 28, 476. <https://doi.org/10.3390/molecules28020476>
13. M. M. Rusu, A. Vulpoi, C. Vilau, C.M. Dulescu, P. Pășcuță, I. Ardelean, Analyzing the Effects of Calcium Nitrate over White Portland Cement: A Multi-Scale Approach. *Materials*, 2023, 16, 371. <https://doi.org/10.3390/ma16010371>
14. I. Lacan, M. Moldovan, I. Ardelean, The Influence of Chitosan on Water Absorption and Solubility of Calcium Phosphate Cement, *Coatings*, 2023, 13(9),1641. <https://doi.org/10.3390/coatings13091641>
15. M.M. Rusu, I. Ardelean, Relations Between the Printability Descriptors of Mortar and NMR Relaxometry Data. *Materials*, 2025, 18, 3070. <https://doi.org/10.3390/ma18133070>

The offer addressed to the economic environment

Research & development	<p>The NMR diffusometry and relaxometry laboratory provides a variety of measurements for characterization of materials. Between these a list of possible investigations is given below:</p> <ul style="list-style-type: none">• Study the effects of various additives and admixtures on cement hydration.• Monitoring the alteration and ageing of rubber or polymers as well as the polymerization processes.• Determination of liquid content inside different porous materials (stone, wood, ceramics, catalysts, bricks, soil, etc.) and the pore size distribution.• Determining the degree of deterioration of lubricants.• Study the effectiveness of contrast agents used in MRI.• Determining the water content, and its distribution inside foods and seeds.• Determining the permeability of soils to certain pollutants; 2D optical images with resolution of up to 1µm of various non-transparent materials.
Consulting	<p>We provide consultancy services on NMR techniques and their applications in medicine, oil industry, study of pollutants transport in soils, pore size characterization, study of cement-based materials, etc.</p>
Training	<p>Training of personal in the field of NMR diffusometry and relaxometry techniques and their applications</p>

Last updated: February 2026