The research activities of RM2I team (NMR and Inorganic Materials) are focused on the methodological developments in Solid-State Nuclear Magnetic Resonance (NMR), their applications to the structural study of inorganic materials and the design of new oxide glasses. Our action is characterized by a strong interface between the fundamental and applied aspects, which leads to a high efficiency in the transfer of methodologies to applications in partnerships with industrials.

**Methodological Developments.** We develop new NMR experiments for the application in the structural studies of materials. Our continued research effort leads to the development of new pulse sequences to obtain high-resolution NMR spectra with a better sensitivity. Our strategy relies also on a better characterization, through novel methods, of the local environment of the observed nuclei (nature and number of first and second neighbours, observation of chemical bonds), in particular to study chemical proximities between quadrupolar nuclei ($^{27}$Al, $^{11}$B, $^{17}$O, ...) and spin 1/2 nuclei ($^{31}$P, $^{29}$Si, $^{13}$C, ...). More recently, we have contributed to the developments of the dynamic nuclear polarization (DNP) NMR technique, which consists in increasing considerably the intensity of the NMR signal by transferring polarization from the electrons to the nucleus. All these methods make it possible to obtain precise NMR parameters that are essential for a better understanding of the relationships between atomic structure and macroscopic properties.

**An Integrated Approach in Catalysis.** Contrary to other characterization techniques which either require a long-range order (diffraction), are highly model-dependent (EXAFS), or are essentially qualitative (vibrational methods), NMR is a local probe that characterizes the atomic environment of materials whether they are ordered or disordered. An important aspect of our research is thus to develop the use of new NMR methods, in particular through our development of pulse sequences for quadrupolar nuclei, for the characterization of alumina or silica surface-grafted catalytic systems with high potential for industrial applications. For example, by combining two-dimensional methods of homo- and heteronuclear correlations, we have published a precise topology of the γ-alumina surface, and closely linked the spectroscopic data to the reactivity of the sites.
New Materials with New Properties. The RM2I team is known for its expertise in the development of non-conventional glassy materials for non-conventional applications, such as, e.g., anti-oxidation protection, glass formulation from liquid, storage of nuclear wastes, and sealing joints. Recently, we have developed a concept of self-healing vitreous materials for applications as protective coating at high temperatures. The idea is based on the deposition of thin layers of a few tens of nanometers on a substrate, while alternating a glass film with a film of healing intermetallic agent. One of our first concerns is to model the structural and property changes within the material associated with the Pulsed Laser Deposition (PLD) compared to bulk glass. Here again, NMR is an effective method for providing structural information about these layers, although it is strongly limited by the small quantities of available samples. This is the reason why we are developing the use of DNP NMR, which allows a signal to be obtained on very limited quantities of sample (less than a mg).

FLAGSHIP PROJECTS
The RM2I team, through its continued research investment in the methodological developments of solid-state NMR, gained international recognition, which allows us to carry ambitious projects at the national and international level. Since 2004, two very high-field NMR spectrometers of 18.8 T and 21.15 T have been installed for a total budget of 6 M€. The national infrastructure IR-RMN contributes partially to the annual budget of the University of Lille NMR Platform, for nearly 100 k€. All members of the RM2I team participate in research projects for the EUSMI and IR-RMN research infrastructures. Based on our expertise, we are participating to the project of implanting in France the first 28 T NMR spectrometer in 2019-2020. The management of the project is also carried by a member of our team.