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Abstracts – Proposed Lectures

1) Introduction to high-resolution solid-state NMR spectroscopy (90 min)

In the last decades high resolution nuclear magnetic resonance (NMR) has become one of the most powerful tools to investigate the structure and dynamics in molecular systems. It is widely known that NMR methods may be widely used for investigating samples in the liquid (solution) state. But recent developments enable one to study solids as well. Hence, unlike X-ray and neutron diffraction methods which are used so far mainly for solid samples, NMR spectroscopy has emerged to be powerful in studying both solids and liquids. The progress in high resolution is closely related with the distinct progress in the instrumentation of NMR. Its basis are NMR pulse techniques, the measurement of time domain data and the application of one and more dimensional Fourier transformation and/or related mathematical techniques for the solution of the problem of the data transformation into a one or multiple dimensional frequency space. The progress is characterized by the application of high magnetic fields, highly sophisticated NMR pulse sequences, double resonance techniques and other subtle methods to influence the nuclear spin states and to create polarization transfer, fast sample spinning techniques under the magic angles and related methods and, last not least, by the tremendous progress in modern procedures for the NMR data treatment.

It is the aim of the lecture to present

- to explain the basics ideas of NMR

- to characterize the progress in instrumentation, to elucidate advantages and shortcomings

- to present an overlook over principles and possibilities to obtain highly resolved solid state NMR

- to visualize fields of application, from solid-state physics, inorganic chemistry, adsorption and catalysis, to the progress achieved in the study of biologically important systems like proteins, nucleic acids, and membrane components whose high molecular weights and polymeric nature dictate certain behaviours which are adequately understood only if they are studied in both solution and solid states.

- Hence it the aim to reveal that the technique of solid-state NMR spectroscopy may bridge the information gap between conventional solution (NMR, ESR, and optical spectroscopy) and solid-state methods (X-ray and neutron diffraction).

2) NMR on nanostructured materials (90 min)

Examples of our recent research work on nano-structred materials will be presented. This presentation is to be considered as a continuation of our previous presentation but it will not be a lecture for NMR specialists only, but rather than a more general description of conceptions, aims, scopes, material properties and conclusions.

The presentation includes

- studies of size effects on ferroelectric properties of oxide perovskites, such as barium titanate and lead titanate. Temperature. It will be shown that the EPR and NMR methods sensitively probe changes of the structure and the local symmetry in the nanocrystalline material.

- studies of the behaviour of ferroelectric $BaTiO_3$, $NaNO_3$ and other glass-forming molecules embedded into mesoporous materials. The materials used, e.g. MCM materials, possess an effective diameter of internal voids of several nm.

An overview about our recent work will be given.