Structural information on length scales between 0.1 and 10 nm and dynamic information on timescales between 10 ps and 1 ms can be obtained by applying a broad arsenal of EPR (electron paramagnetic resonance) techniques to paramagnetic species such as nitroxide radicals or transition metal ions. The sites of interest in complex materials can be addressed selectively by covalently bound spin labels or by specific attachment of spin probes via supramolecular interactions. Depending on the type of experiment, probe or label concentrations down to 10 or 100 µmol l⁻¹ are sufficient. In this context we develop characterization methods for materials whose function is related to structural features on length scales between 1 and 10 nm. Examples are shape-persistent molecules, macromolecule-metal complexes, catenanes, membrane proteins, polyelectrolytes, and polymer-clay nanocomposites. Main topics of method development are the extraction of spin-spin pair correlation functions from EPR data, distance measurements on nitroxide-transition metal pairs, characterization of inorganic/organic interfaces by small hyperfine couplings, and the detection of changes in the dynamics due to differences in the long-range structure over several nanometers.

**Keywords:**
- EPR Spectroscopy
- ENDOR
- ELDOR
- High-field EPR
- Nanostructure
- Supramolecular Systems

**Cross-links to other projects:**
- Polyelectrolytes - Theory
- Magnetic Resonance at Surfaces
- Organic-Inorganic Hybrid Materials
- Solid-State NMR Spectroscopy

**References:**