Singlet states as on-off magnetic resonance switch in self-assembly systems

Salvatore Mamone[1,2] and Stefan Glöggler[1,2]

[1] Max Planck Institute for Biophysical Chemistry, Am Fassberg 11, 37077 Göttingen, Germany.
[2] Center for Biostructural Imaging of Neurodegeneration (BIN), Von-Siebold-Straße 3a, 37075, Göttingen.
* salvatore.mamone@mpibpc.mpg.de

Abstract: Brief statement of work in English (max**. 80 words).**

Zusammenfassung: Kurze Zusammenfassung der Arbeit auf Deutsch, max. 80 Wörter.

Motivation

Magnetic resonance imaging (MRI) is a non-invasive method with yet unsurpassed visualising capabilities of deep tissue in animals and humans. MRI is based on the response of the magnetization generated by nuclear spins in an applied magnetic field to resonant radio-frequency fields. This principle is inherited from its spectroscopic counterpart, nuclear magnetic resonance (NMR). Because of the intrinsic low sensitivity, MRI has mainly developed around the observation of the signal generated by proton nuclei (^{1}H with spin ½), especially from water in presence of metal-based contrast agents. ^{1}H MRI can suffer from poor contrast with respect to the large background protonated signal in biological sample.

Singlet states are an innovative tool in the field of magnetic resonance.[1–3] These are spin states that can be driven in system of spin-½ pairs and that behave as effective spin-0 system. The defining feature of singlet states remains the possibility of storing and retrieving magnetization into singlet states for periods that can exceed the characteristic spin memory time T1.[4,5]

Here we propose to use singlet states as intrinsic on-off magnetic switches that probe the self-assembling/disassembling state in peptidic nanostructures. The Ile-Phe dipeptide has been chosen as above a threshold concentration in water it condenses into a transparent, thermoreversible gel characterized by networks of fibrils prototypical of amyloid formation.[6] We show how the singlet state in the β-protons of the Phe residue can be reversibly switched on and off when the temperature of gel formation is crossed demonstrating that singlet states can be used as a sensitive contrast probe between the liquid and gel phase.

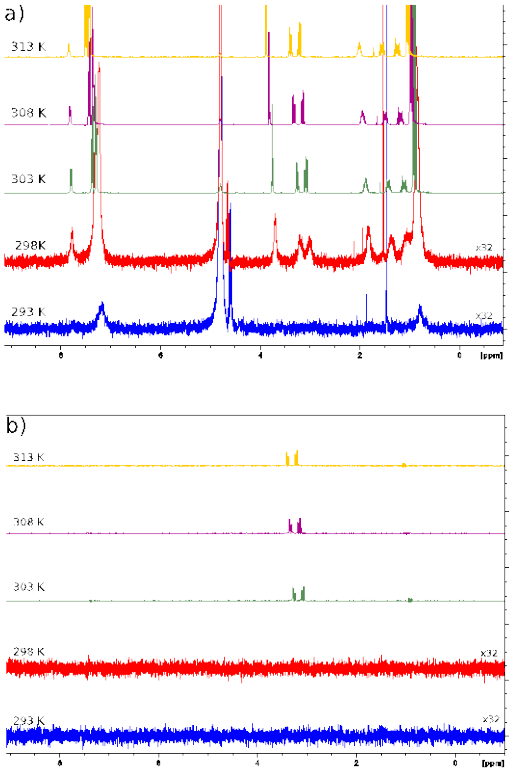

Fig. 1: The 1H NMR spectrum of 2% v/w Ile-Phe in H_2O/D_20 (95%/5%) between 313K and 293K is shown in panel a). At 298K there is a phase transition from liquid to gel. The NMR lines becomes broader but are still visible. In the singlet state filtered experiments shown in panel b), only the signal from the β-protons of the Phe residue are detected in the liquid phase but on gel formation the singlet is switched off and no signal is observable.

Referenzen

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