Application of T_2-filter: Signal suppression for polymers

Product used : Nuclear Magnetic Resonance (NMR)

Application and Features

This technique is suitable for mixtures. The T_2-filter suppresses broad signals of components with short T_2 relaxation times such as polymers and biomacromolecules. While the signals of these high molecular weight components are suppressed, signals of small molecules can be selectively observed. For example, this technique is effective in the analysis of small molecule additives added to polymeric materials, protein-ligand binding studies, and blood plasma analysis in metabolomics.

Principle of T_2-filter

Fast decaying components in FID (Free Induction Decay) become broad signals in NMR spectrum after Fourier Transform. In general, ^{1}H signals of polymers and signals of exchangeable protons, such as OH and NH protons, tend to be broad (Fig. 1a). On the other hand, FID signals of highly mobile small molecules decay slowly and become sharp signals in NMR spectrum after Fourier transform (Fig. 1b). The fast decaying components have short T_2 relation times, whilst the slowly decaying components have long T_2 times. To make benefit of different T_2 relaxation properties, the T_2-filter is applied at the very beginning of the pulse sequence and then acquisition of NMR signal follows. Under the conditions shown in Fig. 2, the acquisition starts after the fast-decaying signals have decayed. As a result, the broad signals are suppressed, whilst the narrow signals are observed.

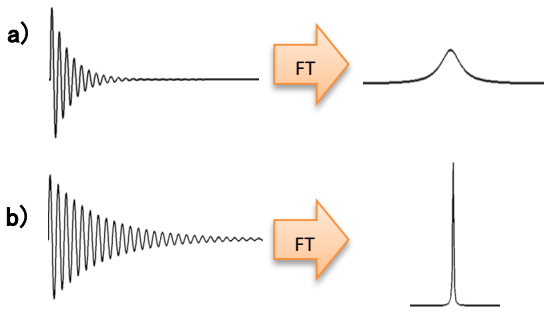


Fig. 1: Decay time and line width of a) fast decaying signals, and b) slow decaying signals

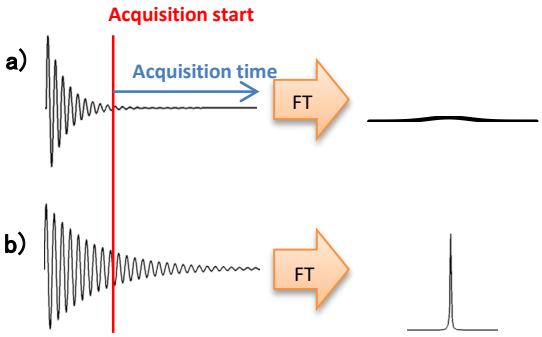
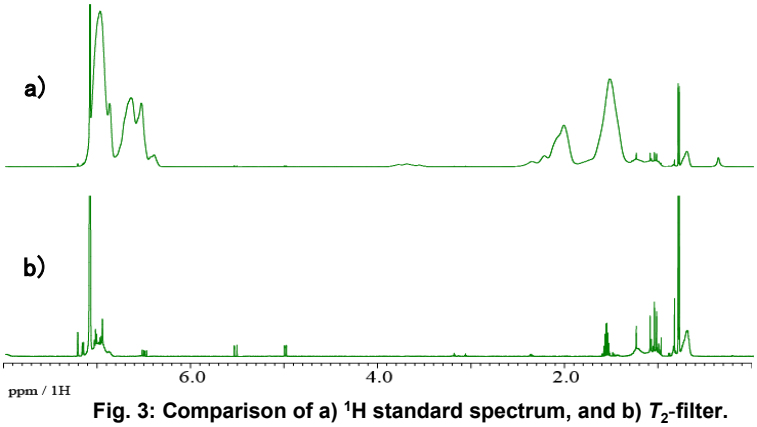


Fig. 2: Effect of T_2-filter on a) fast decaying signals, and b) slow decaying signals

For example, the experiments used for T_2 measurements are the CPMG (Carr-Purcell-Meiboom-Gill) and PROJECT (Periodic Refocusing of *J* Evolution by Coherence Transfer) experiments. The same experiments can be used for T_2-filtering. Here we demonstrate T_2-filtering on a sample of Styrofoam. Fig. 3 shows comparison of (a) standard and (b) T_2-filtered ^{1}H spectra. The T_2-filter reduces the broad components (mainly polystyrene) very efficiently in Fig. 3b, and hence the sharp signals previously invisible become visible.



Parameters of T_2-filter
Experiment: cpmg_project.jxp
Scans: 32
Delay_list: 2.5 [s]
Tau_step: 10 [ms]

Fig. 3: Comparison of a) ^{1}H standard spectrum, and b) T_2-filter.

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