6.1 ^{87}Rb 2D-Exchange NMR Investigation of the Cluster Dynamics in D-RADP-50

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The size of the antiferroelectric (AFE) clusters in the glass phase of D-RADP-50 was found to be of the order of one nm. We can thus expect a considerably shorter life times of these clusters than the ones of the FE domains in D-RADP-25. The orientation of the crystal in the external magnetic field was chosen to have maximum splitting between the 4 AFE resonance lines in order to exclude spin diffusion. Unfortunately the minimum of the ^{87}Rb T_1 (1 ms) is located at 90 K which is in the center of the dynamically interesting region. Therefore a special difference exchange pattern has to be generated by means of a specially designed phase cycling scheme which compensates also for T_1 effects.

The first experiments revealed a very promising exchange signal from which a preliminary 2D Fourier transform was performed. The 2D contour plot shows on the diagonal the signal (with negative intensity) of all ^{87}Rb which have changed their resonance frequency within the mixing time, and as positive off-diagonal signals the same ^{87}Rb connecting the start and end frequencies. The signals of the ^{87}Rb nuclei which did not undergo frequency changes within the mixing time are eliminated by the substraction of the total signal. The mayor off-diagonal signals in the contour plot are in a very close parallel line to the diagonal. This is probably the result of uncorrelated deuteron hopping on the hydrogen bonds leading to small ^{87}Rb frequency changes.

Extended 2D exchange measurements have been performed at various temperatures. The recording time for one 2D-spectrum of this type extends from about two to five days. In all cases we have found the main off-diagonal part of the signal intensity as close as 2 kHz from the negative main diagonal signal. This feature is even present at room temperature where it can be unambiguously assigned to spin diffusion. At this temperature the deuteron dynamics is so fast that its influence on the Rb signal is completely time averaged so that no contribution to the exchange signal is possible. At low temperatures, where the inhomogeneous broadening of the central Rb NMR line reaches up to more than 50 kHz and where the deuteron dynamics becomes slower than the induced Rb line splitting, the deuteron motion becomes visible in the exchange spectrum. No signals of entire cluster dynamics could be observed so far. This means that very likely the long time zero average of the local polarization is achieved rather by cluster wall motion than by the inversion of the cluster sublattice polarization.