NMR spin echo study of RF-Induced Flux Lattice Annealing (RIFLA) in CuO superconductors

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A strained flux lattice configuration can be formed in a type II superconductor in a magnetic field by changing the field magnitude or alignment at a temperature well below the superconducting transition temperature. In this circumstance, the flux vortices are not pinned to pinning sites in the configuration with the lowest free energy. The rf pulses then used to obtain an NMR spin echo signal vibrate the flux lattice and can cause its configuration to change to one with a lower free energy. Here, this process is named RF-Induced Flux Lattice Annealing, or RIFLA. The result can be a progressive change in the local magnetic field at the sites of the nuclei following each pulse used to generate a sequence of spin echo signals. When this change in the local field between the dephasing and rephasing periods is large enough and different at different nuclear sites, the result is to reduce the amplitude of the echo from its value when changes in the local field between the dephasing and rephasing periods are absent. Upon starting a sequence of spin echo measurements in the strained flux lattice conditions, the amplitude of the first echo can be very small, and becomes progressively larger as the flux lattice is further annealed by additional pulses. Measurements and analysis of this RIFLA effect on the increase of the echo amplitude in a cuprate superconductor are presented, as well as reductions in the inductance of the NMR coil as the vortices become more strongly pinned by the annealing of the flux lattice.