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Nuclear magnetic relaxation induced by the relaxation of electron spins

Borich M., Bunkov Y., Kurkin M., Tankeyev A.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2017, Pleiades Publishing, Inc.A physical mechanism responsible for the relaxation of nuclear spins coupled by the hyperfine interaction to relaxed electron spins in materials with spin ordering is proposed. The rate of such induced nuclear spin relaxation is proportional to the dynamic shift of the nuclear magnetic resonance (NMR) frequency. Therefore, its maximum effect on the NMR signal should be expected in the case of nuclear spin waves existing in the system. Our estimates demonstrate that the induced relaxation can be much more efficient than that occurring due to the Bloch mechanism. Moreover, there is a qualitative difference between the induced and Bloch relaxations. The dynamics of nuclear spin sublattices under conditions of the induced relaxation is reduced to the rotation of m1 and m2 vectors without any changes in their lengths (m12(t) = m22(t) = m02(t)= const). This means that the excitation of NMR signals by the resonant magnetic field does not change the temperature Tn of the nuclear spin system. This is a manifestation of the qualitative difference between the induced and Bloch relaxations. Indeed, for the latter, the increase in Tn accompanying the saturation of NMR signals is the dominant effect.

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